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THE NEW ZEALAND PLANT RESEARCH STATION.

CURRENT MYCOLOGICAL INVESTIGATIONS.

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THE Plant Research Station was established at Palmerston North last April as the result of an arrangement arrived at between the Department of Agriculture, the Scientific and Industrial Research Department, and the Massey Agricultural College. The present control of this organization is vested in a committee composed of representatives of the two Departments and the College, with, in addition, members representing the commercial and farming interests of the Dominion.

The Station has been instituted primarily with a view to conducting on scientific lines investigations into problems affecting agriculture in its widest sense. Thus all problems affecting the production of agricultural crops and crop products (as seeds), horticultural crops, grasslands, and forest stands (both exotic and indigenous) come within the scope of the Station. At present special attention is being paid to the production of disease-free nucleus lines of pedigree agricultural seeds; to the furtherance of seed-production on a commercial scale; to the extension of seed export; to the systematic study of the New Zealand flora, both phanerogamic and cryptogamic, indigenous and introduced; to the improvement of pastures and pasture plants; and to the study of all plant diseases occurring within the Dominion.

This article deals specially with the plant-disease work at present being undertaken by the mycological staff of the Station. As one of the objects aimed at is the production of disease-free pedigree nucleus lines of agricultural seeds, this phase of the work is closely associated with the work of the Agronomist; for he has first to produce lines of pedigreed seed before the matter of rendering such disease-free can be undertaken. Experience of the past few years has shown that, in New Zealand at least, the annual losses due to plant-diseases are so great that profitable farming is dependent on successful disease-control.

Now, as the majority of diseases of agricultural crops (and others, too, for that matter) are seed-carried, it follows that the best method

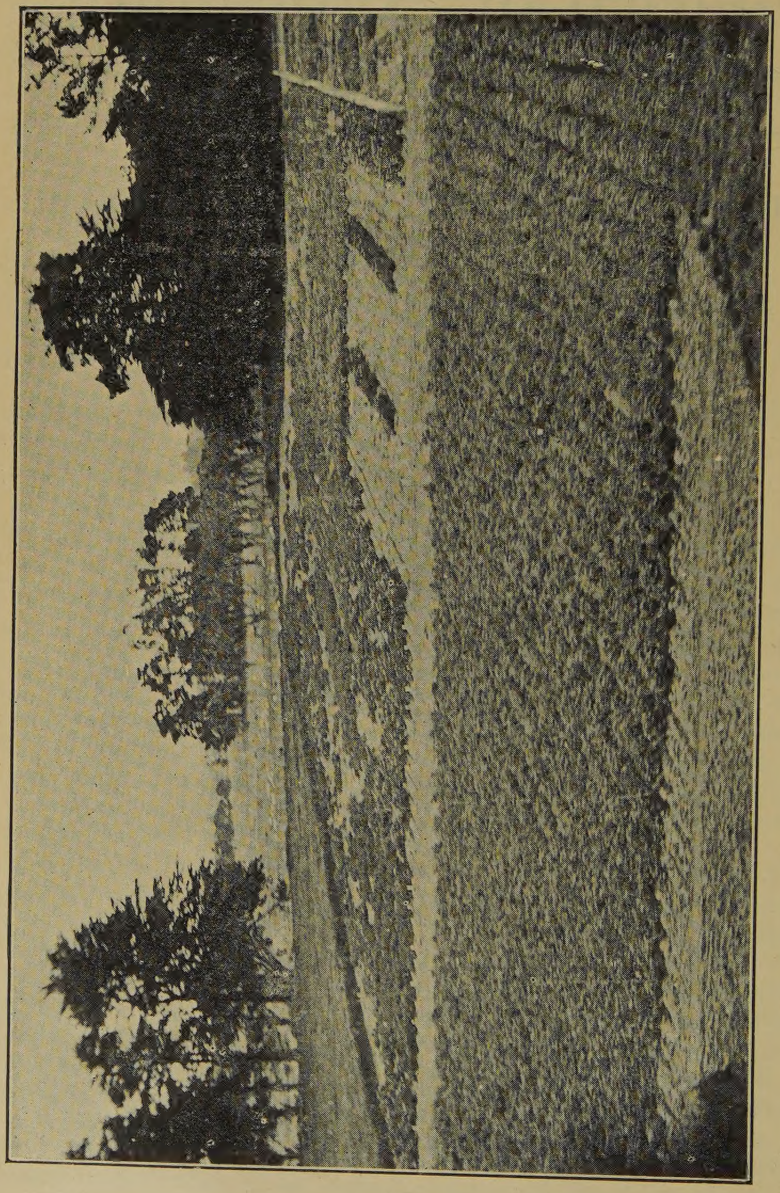


FIG. 1. POTATO EXPERIMENTAL AREA AT THE PLANT RESEARCH STATION FARM.
The blanks seen in the plots indicate plants removed during rogueing. [*Photo by H. Drake.*

of dealing with such diseases is to eliminate them from the seed. Consequently, if the lines used commercially were disease-free, then not only would the resultant crop be disease-free, but the necessity for practising any seed-treatment would be obviated. Theoretically, in the course of a few years such a practice, if followed up consistently, would result in the elimination of all seed-borne diseases from the agricultural crops of the Dominion, a matter which would not only assist in securing a sound economic basis for farming, but would also result in direct saving of a very large sum of money annually. Unfortunately, the matter is not merely one of treating all seeds with some panacea; for experience has taught that practically each disease requires its special treatment; and it must be admitted that no control is at present known for many. Then again, constant reinfections occur in the field from volunteer host-plants, weeds, soil-contaminations, and the like; from threshing-plants, bags, and other containers; drills and other farm implements. And, what is of greater significance, many of our diseases are annually imported from overseas with the seed. Consequently, before elimination of seed-borne diseases can successfully be undertaken a control has to be evolved for each disease under consideration, necessitating careful work on each and every one attacking our crops; the whole of the farming technique has to be reviewed and possibly revised, and especially provision made for the prevention of entry of imported seeds carrying certain diseases of economic importance.

Such work calls for a completely equipped pathological research station, with laboratories, glasshouses and land, and a staff of specially trained pathologists with adequate equipment. Such has been or is to be provided at the Plant Research Station. Work was commenced in April last, investigations being conducted upon the diseases of cereals, potatoes, peas, brassicas, tomatoes, and certain timber-trees and timbers.

Cereal Diseases.

As the past four seasons' work* has led to efficient control methods with the smuts, work this season has principally been along the lines of combating other major diseases, such as stripe of barley and take-all of wheat.

Barley-stripe (*Helminthosporium gramineum*) is carried with the seed, as preliminary work has demonstrated; consequently control experiments have been directed towards the evolution of a treatment for its elimination, since the hot-water treatment so successful against loose-smut of barley and wheat is not effective against stripe. A large series of different treatments has been carried out, the treated seed being sown on the Station farm. Since practically the whole of the commercial malting-barleys of Canterbury have been rendered smut-free as a result of the practice of the methods at present adopted—that is, by the treatment of nucleus lines, and bulking these subsequently under aseptic conditions—stripe remains the only other serious disease of this crop with which we have to contend.

Take-all (*Ophiobolus graminis*) has proved the most serious disease of wheat in the Dominion, since in certain localities it may cause an annual loss of up to 70 per cent. Despite the amount of investigational

* This and several other branches of mycological work were previously carried out in connection with the Biological Laboratory of the Department of Agriculture, at Wellington.

work being conducted with this disease both in New Zealand and abroad, its life-history is yet but imperfectly known. Although foreign workers have not found it to be seed-carried, our preliminary laboratory and glasshouse experiments conducted have shown that seed taken from take-all areas will, under favourable conditions, produce take-all-infected plants. But, despite numerous experiments, such infected plants have not been obtained in the field. Consequently, work this season has been directed towards obtaining take-all in the field, under natural conditions, firstly to substantiate the laboratory experiments, secondly to supply infected soil in quantity sufficient to enable persistence and host-range studies to be undertaken. Approximately 3 acres have been sown on the farm with seed taken from take-all areas in the South Island.

The rusts of wheat (*Puccinia graminis* and *P. Elymi*), of oats (*P. graminis* and *P. coronata*), and of barley (*P. anomala*), as a rule, appear too late in the season to cause much damage. But, as in certain seasons these fungi may cause appreciable damage, especially *P. coronata* on oats and *P. graminis* on wheat, they will form the subject of further investigation. As a preliminary, the differential hosts used in North America for determination of physiological forms are being grown this season on the farm to provide sufficient material for subsequent work. As all these rusts are heterœcious, and as in no case do the alternate hosts occur in New Zealand, it is evident they are perpetuated in some manner other than the customary way; consequently special attention will be directed towards their methods of overwintering.

Potato Diseases.

With the potato crop work has been concentrated upon the production of pedigreed disease-free nucleus lines of commercial varieties. At present some 2½ acres on the farm are sown to pedigreed selections (made by the Agronomist) of all potato varieties grown in the Dominion, for the purpose of eliminating from them diseases which are carried with the tuber. As all potato-diseases present in New Zealand are tuber-borne, the problem of producing nucleus disease-free lines becomes one of intensive rogueing, together with a system of tuber-treatment for those diseases which may be combated in this manner. In addition the methods by which the diseases may be spread in the field, or may be carried from one season to the next, are being investigated so that precautions can be taken to minimize contamination of the disease-free lines from extraneous sources.

Potato-diseases fall into three fairly well defined groups: (1) Those which are responsible for "blanks" and stunted plants; (2) those which cause wilt and death of plants in the field; (3) those which cause a general reduction in yield.

Of the first group, corticium disease (*Corticium Solani*) is of the greatest economic importance, since it is present in practically every line grown and takes a considerable annual toll. Its effects are noted shortly after the majority of the plants have come well above the ground. Certain plants in the rows either do not appear at all, or send up a few spindly, weak, and late shoots. If the tuber is lifted at this stage it will be seen that most shoots show cankers near the tuber, many of which have cut off the top of the shoot, causing fresh

growths to appear from beneath the point of infection. Sometimes this may happen four or five times; consequently the shoots are much delayed, and often killed outright. Hence the small size of such plants and the frequent "blanks" in the rows.

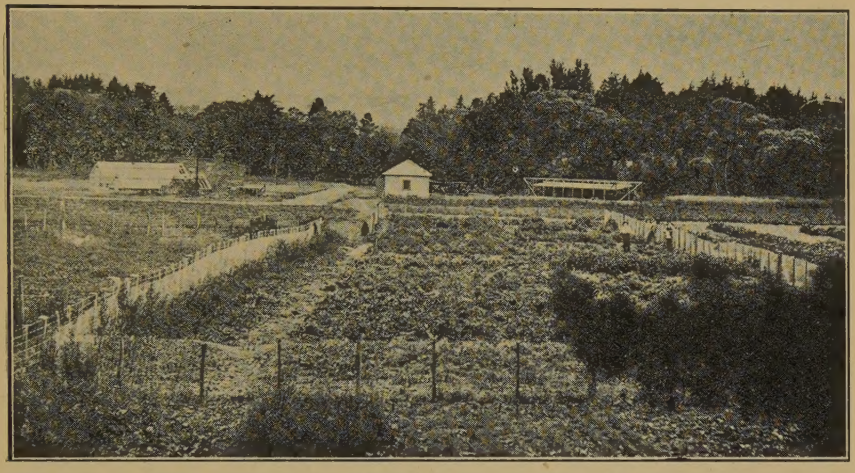


FIG. 2. THE PEA AREA, WITH PICKING OPERATIONS IN PROGRESS.
In distance, glasshouse, steam sterilizer, implement-shed, and insect-proof cages.

FIG. 3. EXPERIMENTAL BARLEY AND WHEAT PLOTS (ON LEFT); CORTICIUM AREA (IN FOREGROUND); PEA COLLAR-ROT PERSISTENCE AREA (MIDDLE DISTANCE); LINSEED (IN DISTANCE ON RIGHT). [*Photos by H. Drake.*

As a result of previous work a treatment had been evolved for the control of corticium. Although this has not proved a practicable one for farmers, it has been used successfully for eliminating this disease from all the pedigreed lines now growing on the Station farm.

Previous experiments in the control of corticium disease tended to show that the disease may possibly carry over in the soil from season to season, and this has led to conflicting results being secured in control experimental work. Consequently a series of experiments has been planned to determine whether the disease does really carry over in this manner; and, if so, whether any rotational, manurial, or soil treatment will tend to shorten or eliminate this period of persistence. For this purpose 1 acre has been planted with tubers known to be infected with corticium disease, with a view to infecting the soil, to enable subsequent experiments to be undertaken. Experiments on these lines have been planned to cover four seasons.

The diseases of the second group, usually termed "wilts," are due to the following organisms: (1) Vascular wilts (due to one or more species of *Fusarium*); (2) mattery-eye (a bacterial disease due to *Phytomonas Solanaceara*); (3) sclerotium disease (due to the fungus *Sclerotinia sclerotiorum*). Their presence is shown by sudden wilt of the foliage of one or more stems, followed by death of the part affected, or often of the whole plant. Often the tubers show a brown discoloration in the vascular ring, but this is not a definite character, since it may be due to other agencies. Nevertheless, when such discoloration is noted it is an indication that the tuber is diseased; consequently such tubers should not be planted for seed. Mattery-eye is expressed in an aggravated form, wilt of the whole plant being rapidly followed by its death; the tubers show a strongly discoloured vascular system, and in addition often decay rapidly, emitting at the same time an unpleasant smell similar to that of decaying fish. The vascular wilts are present in most commercial lines to the extent of between 10 and 20 per cent.

The third group contains what are now known as virus diseases. Such are not due to bacterial or fungous agency, but to some infective principle, the nature of which is at present unknown. Virus diseases are transmitted in the tuber, and may be carried from plant to plant by insects such as aphids. Consequently if clean seed is used, and insects vigorously excluded from the crop, a clean line may be obtained. This group of diseases may be detected in the crop by their effects upon leaf, stem, and tuber; but, as the symptoms are numerous and complex, a special training in virus work is necessary before rogueing of infected plants can be successfully practised. In New Zealand several types of virus disease are present; but whether these are different diseases, or different expressions of the same disease, is not known, nor is there any agreement among those working on the plant-virus problems. Mild-mosaic, rugose-mosaic, aucuba-mosaic, leaf-drop, stipple-streak, spindle-tuber, curly-dwarf, leaf-roll, streak, and wildings are all present in New-Zealand-grown commercial lines. This group of diseases is chiefly responsible for a very considerable decrease in the annual yield of the potato crops of the Dominion, some lines having depreciated to such an extent that they are commercially unprofitable, producing less than 3 tons per acre; consequently, economically, this group is the most significant of those attacking the potato.

One other disease common on potatoes is late-blight, caused by the fungus *Phytophthora infestans*. This does not fall into any of the groups noted, since it is sporadic in its appearance, being governed by two factors—(1) temperature and humidity of the areas during the growth period, and (2) its presence or absence in the tubers planted in those areas.

Work this season has been directed against the elimination of all diseases enumerated from the pedigreed lines growing on the farm. Next season part of these will be bulked in Canterbury prior to distribution to certain selected growers, and part will be retained on the Station farm for further rogueing. During the winter months certain of these tubers will be grown in the glasshouse under control conditions, to enable life-history studies of virus and other diseases to be undertaken under New Zealand conditions.

Pea Diseases.

Two major groups of field-pea and garden-pea diseases have proved serious problems to growers. These are collar-rot (embracing several related organisms) and virus diseases.

Collar-rot is a seed-borne disease, and this season an extensive series of experiments has been undertaken with both field and garden peas with a view to finding a method of control. Field experience has also tended to show that the disease may persist for one or more seasons in the soil. To determine whether such is the case, approximately 1 acre has been sown with a line known to contain collar-rot, with a view to infecting the soil. Should such be the case a four-years course of experiments has been planned to determine the period of persistence, and whether any soil, manurial, or rotational treatment will reduce or eliminate this soil-borne phase.

Pedigree selections of all commercial lines of garden-peas (made by the Agronomist) have been grown on the farm with a view to rendering these free from all seed-borne diseases, such as collar-rot and virus disease. These have been rogued repeatedly, and are at time of writing being harvested. Part of each line will again be grown on the farm for further selection work next year, and the remainder bulked for commercial distribution. Approximately 3 acres of field-peas, of three commercial varieties, have been treated for collar-rot and grown on the farm, the object being to provide sufficient disease-free seed for commercial distribution.

Diseases of Brassicas.

One of the major agricultural crops grown in the Dominion is the brassica crop—turnips, swedes, and rape. Owing to the considerable improvements in pasture establishment and maintenance which have taken place during recent years, the carrying-capacity of our grasslands has been considerably increased. But no improvement has yet been evolved to enable pastures to maintain their maximum carrying-capacity for more than at most three parts of the year. If the farmer wishes to retain the maximum carrying-capacity of his farm the year round (apart from hay or ensilage) it is necessary that he provide a supplementary crop for that period when grass-production is low. Often, too, he requires an additional summer supplementary crop so

that he may "top off" fat stock for the market. Undoubtedly the best supplementary crop is the swede or turnip, and the best summer supplementary crop is rape. But owing to the increasing spread of dry-rot and club-root it is becoming difficult, and in certain localities impossible, to grow satisfactory crops of either. Owing to the great significance of these two diseases, dry-rot and club-root have been made major projects in this and subsequent seasons' work at the Station.

Practically all rape, swede, and turnip crops grown in New Zealand are grown from seed imported from abroad, principally from Britain. Previous work has shown that dry-rot is carried in seed; recent field surveys have shown that it is probable club-root is similarly carried, though European investigators have claimed such is not the case; but the frequent occurrence of this disease in crops grown on virgin land has a significance which cannot be overlooked, despite European work.

Dry-rot. — This season's work consists in ascertaining whether the disease persists in the soil for one or more seasons; and, if so, whether any soil, manurial, or rotational practice will reduce or eliminate such. Land on the farm artificially infected with dry-rotted mummified swede bulbs has been sown with a line of swede-seed found to be free from dry-rot in the laboratory. An insect-proof cage has been constructed consisting of three compartments, each insulated from the others by insect-proof mesh, and below the ground-level for a depth of 2 ft. with zinc sheeting. This has been built on the lines of an entomological insectary, phosphor-bronze netting being used throughout. The function of this structure is to determine under controlled conditions whether swede-seed found to be dry-rot-free in laboratory tests remains free when grown to maturity; whether seed infected with dry-rot will produce diseased plants; and whether such seed when treated with the method recommended by the laboratory will remain dry-rot-free. Such evidence should demonstrate conclusively whether the laboratory evidence that dry-rot is seed-borne is substantiated in the field.

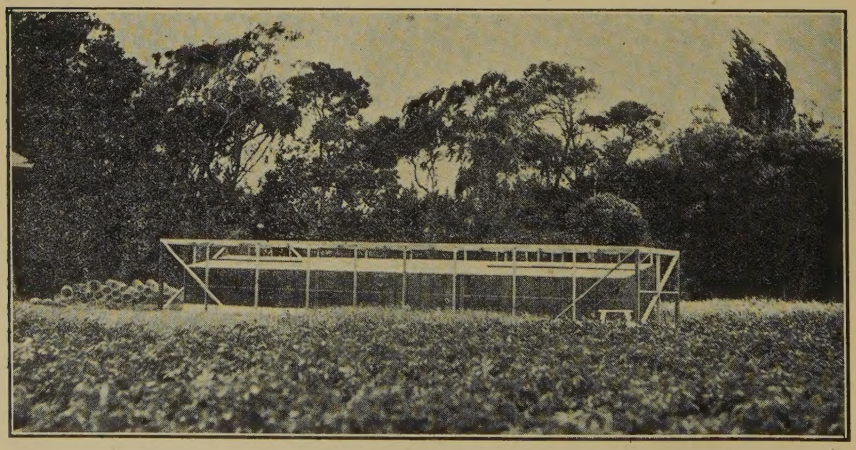


FIG. 4. INSECT-PROOF CAGES IN COURSE OF CONSTRUCTION (TO BE USED IN DRY-ROT EXPERIMENTAL WORK).

[*Photo by H. Drake.*

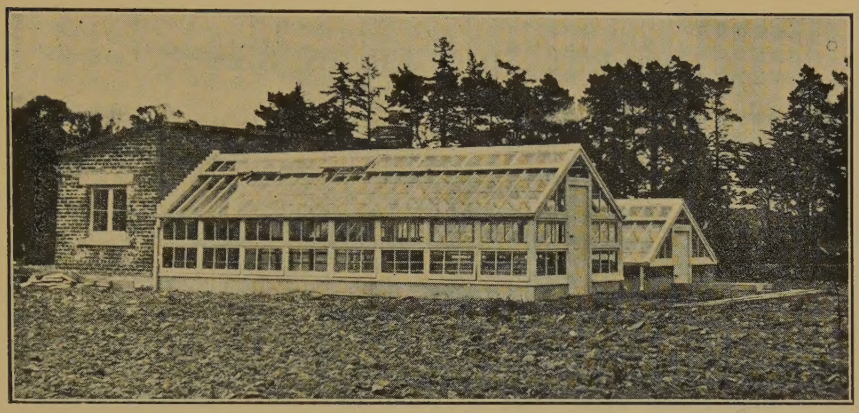


FIG. 5. THE GLASSHOUSES AND ATTACHED WORK-ROOM.
[*Photo by H. Drake.*

In addition a commencement has been made to procure certain nucleus lines of swede-seed, disease-free and true to type, as a basis for commercial bulking and distribution ; so that in the event of British seedsmen failing to comply with this country's requirements in the matter of producing dry-rot-free swede-seed sufficient material will be available to enable bulk seed-production to be undertaken within New Zealand.

Club-root.—This disease is known to persist in the soil for several seasons, but the exact length of this period of persistence is not known. Consequently work is being undertaken to determine exactly how many years club-root remains in the soil, and if it is possible by any soil, manurial, or rotational treatment to reduce this period. For this purpose 1 acre has been planted with artificially infected rape-plants, so as to ensure that the land is contaminated with the disease. The duration of this series of experiments is expected to be seven years. The effect of brassica weeds is being considered in connection with this work, since it is possible that one or more of these may tend to carry over the disease indefinitely. Attention is being paid to the possibility of club-root being carried with the seed, numerous box cultures being under way with this objective in view.

General.

Other projects in hand are the investigation of tomato-diseases ; dying of *Pinus radiata* ; manufacture and distribution of cultures of the lucerne nodule organism (sufficient to inoculate 2,500 lb. of seed having been sent out to farmers throughout the Dominion during the past three months) ; investigation of forest nursery diseases ; timber-rots and sap-stains ; and systematics of the New Zealand fungi.

In addition to the insect-proof cages already mentioned, a special pathological glasshouse has been erected, consisting of a series of compartments, each capable of being maintained at one of three constant temperatures. Laboratory and other buildings will be erected at the Station farm as soon as certain particulars concerning structure and appointments are available ; the staff at present is housed in temporary quarters in the town, some distance from the farm.

MINERAL HUNGER IN SHEEP.

SUCCESSFUL TREATMENT BY PELLET-FEEDING METHOD.

B. C. Aston, F.N.Z.Inst., Chief Chemist, Department of Agriculture.

It has been a comparatively easy matter to adjust mineral deficiency in the diet of cows and calves, and to cure suffering stock completely when once the kind of deficiency has been determined. This species of ruminant is more easily treated than sheep for deficient mineral foods, dairy cows and calves being frequently handled or artificially fed or watered, thus giving an excellent opportunity to correct their natural diet by the addition of the mineral in suitable forms, or of drenching them when that extreme form of treatment becomes necessary.

With sheep the difficulty of giving any adequate medicinal treatment will be seen when it is remembered that the treatment does not become obviously necessary until the animals are far gone and so emaciated that weeks of treatment may be necessary to bring them back to health ; that they are comparatively little seen and infrequently handled, and roam over a great extent of country of a much rougher nature than that on which cattle are usually pastured ; that they water themselves, where they drink at all, from creeks or water-holes ; and that they often refuse to take salt licks, even when it is possible to give them the required mineral in that form.

The method which Dr. J. B. Orr and the Rowett Research Institute officials have adopted under somewhat similar conditions existing in Scotland is that of giving the mineral supplement mixed with dry concentrated food, such as oil and meals, pressed into small cube-shaped pellets, each of which contains enough per day for one sheep. Dr. Orr explained the method fully when he was in New Zealand in August last, and after the writer had shown him this Department's rabbit-poison mixer at Frankton Junction, approved of a trial being made with that machine in the making of pellets with material obtained locally. The meals were duly procured, and, after consulting the Geological Survey reports as to the best and cheapest form of native iron-ore to use, one of the minerals required—iron—was located in a suitable form by the writer in a clay-quarry near Auckland. This is the native carbonate of iron (ferrous carbonate) or spathic iron-ore. How the pellets were eventually made will be seen from Mr. Grimmett's appended account ; and the credit of finding a method of getting the sheep and lambs to devour, with evident relish, a highly mineralized food, which at first they would rather starve than eat, must be attributed to Mr. Cecil M. Wright, Country Analyst in charge of the Rotorua and Te Kuiti experiments, who describes the method adopted fully.

Further trials will be carried out with the pellets, and until the results are to hand no definite advice will be given on the matter. Should the trials prove successful, the application of the method of supplementing deficient pasture, or what is known as poor hogget country, may mean thousands to the pocket of the farmer. It is not

intended that the method shall affect the necessity for top-dressing sheep-country; but there are farmers who cannot afford to purchase fertilizers, and all over New Zealand there are lands which it will not pay to top-dress. It is under these conditions that the cheapness of the pellet method will appeal to the struggling settler and to the owner of poor country.

Report by R. E. R. Grimmett, Analyst, Chemistry Section, on Preparation of Pellets.

Up to the present, pellets containing minerals have been prepared according to three main formulas, designated Nos. 1, 2, and 3, and are intended for use in three classes of deficiency.

No. 1 is a general mixture of minerals intended as a mineral supplement for animals grazing on herbage of low ash-content where deficiency is not confined to a single element, or in cases where the deficiency has not yet been identified. It may also be of use for breeding-ewes or for hastening the rate of growth of lambs (in both of which cases the demand for minerals is great) on pasture of average mineral content. This mixture is a modification of that used successfully under the direction of the Rowett Institute for sheep on hill country in Scotland. The formula, for one charge of the machine, is as follows:—

Steamed bone-flour	6 lb. 4 oz.
Whiting (calcium carbonate)	7 lb. 14 oz.
Ground spathic iron-ore (ferrous carbonate)	1 lb. 4 oz.
Common salt (sodium chloride)	1 lb. 4 oz.
Sulphur	1 lb. 4 oz.
Potassium iodide	2·75 grammes.
Copra (coconut-meal expressed)	8 lb. 2 oz.
Rice-meal	3 lb. 2 oz.
Peanut-meal	7 lb. 8 oz.
Flour	4 lb. 0 oz.
Cod-liver oil	1 lb. 0 oz.
Anise	To flavour.

The purpose of the oil is primarily to prevent the pellets becoming too horny when dry. In addition it is stated to assist the assimilation of the minerals, particularly calcium and phosphorus. The mixture of the meals is intended to increase palatability as well as to obtain a suitable crumbly consistency, and may be modified as found desirable.

No. 2 is an experimental mixture designed to prove whether calcium deficiency exists, apart from phosphate deficiency, in areas where both constituents are low in the pasture and the soils show marked deficiency of lime. The field-work has not yet reached the point of elucidating this point. The mixture consists of—

Whiting	35 lb. 0 oz.
Common salt	2 lb. 8 oz.
Copra	32 lb. 8 oz.
Flour	12 lb. 0 oz.
Cod-liver oil	4 lb. 0 oz.
Anise	To flavour.

No. 3 is a mixture designed to supply iron to sheep grazing on the iron-deficient pumice lands. It consists of—

Iron ammonium citrate	2 lb. 8 oz.
Copra	24 lb. 0 oz.
Flour	16 lb. 4 oz.
Peanut-meal	9 lb. 0 oz.
Cod-liver oil	2 lb. 8 oz.
Anise	To flavour.

The pellet-making machine is a converted poison-mixer, fitted with a new end-plate having 1 in. holes, and with pipes for supplying steam. The minerals, meals, and oil are mixed dry, water is added until the mixture is crumbly, and steam is then admitted with further mixing until the mass is thoroughly hot and coherent. It is then forced through the holes, suitable adjustment of the cutters giving pellets about 1 in. long. These are spread out on trays, sprinkled with anise, and set in the sun to dry. After air-drying, they are further dried and lightly toasted in an oven to prevent the growth of moulds.

Dose: The pellets when dry weigh about $\frac{1}{8}$ to $\frac{1}{5}$ oz. each, depending on the mixture. The number of pellets required at a time will depend on the frequency of the feeding and the liking the animals have for them, as they may not always eat a full dose. About $\frac{1}{2}$ oz. to 1 oz. of Nos. 1 and 2 (two to four pellets) and 1 oz. to 2 oz. (five to ten pellets) of No. 3 should be sufficient, if fed each day or each alternate day. What the lowest effective limit may be, however, is not known. It is hoped that this point may be determined in the course of the experiments.

Report by C. M. Wright, Country Analyst, on Pellet Method of Feeding Minerals.

The feeding of minerals other than by licks and top-dressing has been successfully and extensively tried in Scotland and Kenya Colony. The idea is to incorporate in a mixture of meals and oils the mineral or minerals known or suspected to be lacking in the pasture the stock are eating, when top-dressing has not successfully dealt with the malnutrition trouble, and also to stimulate the glands to do their work better by the administration of iodine. Even though there may be no suspicion of deficiency of iodine in the pasture it may stimulate the absorption by the animal of certain other elements. The food, which is made up in the form of pellets about $\frac{3}{4}$ in. square, has proved to be an economic proposition as regards cost in both Scotland and Kenya Colony, and there is no reason why it should not be so in New Zealand if farmers are prepared to give the time necessary to train the stock up to taking the food.

It is not suggested that there will be any lessening of the necessity for top-dressing, which is essential for the improvement of grass and carrying-capacity, but it is thought that pellet feeding will be the means of keeping stock healthy until it can be done by means of top-dressing, and for rough country which it is not possible to top-dress. Experiments with top-dressing are necessarily lengthy and comparatively costly, and entail a large amount of work before the desired result is obtained; it is hoped that while those experiments are in progress the pellet method will fill the gap by curing malnutrition, and also help the farmer financially to purchase top-dressing material.

The method of feeding the minerals in pellet form, being a new one in this country, was naturally viewed at first in a critical light, as it was thought that to get stock habitually fed on pastures all the year round to take the food in a different way would be a very difficult thing to accomplish. This difficulty was admitted by Dr. Orr, who stated that it had taken about a year to get the hill sheep in the Highlands to take the food, but that when they had become accustomed to it they would eat the pellets from the shepherd's hands. This entailed a large amount of patience on the part of the shepherds, but the results justified the work and time. It was at first thought necessary that the stock being dealt with should be mustered, and either held or yarded so that they could get the pellets every day until success was obtained. This would seem in New Zealand to be an impossibility; but it is now evident that if some sheep in the flock are educated to take the pellets they will entice others to do the same.

FIG. 1. SHEEP FEEDING AT TROUGH IN YARD ON FARM NEAR ROTORUA.
The nearest ewe has a pellet in her mouth.

FIG. 2. SHEEP EATING PELLETS FROM TROUGH IN PADDOCK.

The animals were driven into a corner and went readily to the trough. Note abundance of grass.

[*Photos by C. M Wright.*

When it was decided to try the method here, the areas where stock were suspected of suffering from mineral starvation were naturally deemed most suitable, and experiments have been put under way in several localities. The most successful results so far have been obtained on a farm near Rotorua. It is mostly due to the interest the owner has taken in the work, and to the patience of his manager, that in a comparatively short time the sheep have taken to eating the pellets, and will now greedily eat them even when scattered on good grass in the paddock.

At first No. 1 pellets were used on this farm. These were a general mixture containing a proportion of spathic iron-ore (ferrous carbonate). The sheep, which were mostly ewes from six-tooth upwards and obviously not thriving, were shut up in a shed with the pellets in a trough, and although they were kept there till it was deemed advisable to let them out owing to starvation, they would not touch the pellets. The pellets were then removed, and chopped-up turnips were substituted in the trough, and these were eaten readily by the sheep. Pellets were then mixed with the turnips and were also eaten, and the quantity of turnips was reduced and that of the pellets increased till pellets only were fed, and were eaten by the sheep from troughs in a small yard. When the animals were accustomed to the troughs outside, these were removed from the yard and put in a paddock; the sheep were then mustered and held there, and they went to the troughs without any trouble. Next, the pellets were scattered on the grass, and now the animals will eagerly search for them on the pasture. A little aniseed-oil is added to the pellets, the idea being that once the sheep get used to the smell of the anise they will more readily smell the food when it is scattered on the pasture, and this appears to be the case.

The sheep used for this experiment were very light, and could easily be held up one on each arm. Most of the ewes lambed after the experiment had been going for about a month, and at time of writing even the lambs are eating the pellets and appear to be going along quite normally. Both the owner and manager state that had the sheep not had the mineral food they would have been dead long ago. Towards the conclusion of the experiment, which has been going on since the middle of September last, the No. 1 pellets were replaced by No. 3, which are simpler in composition, containing only the necessary iron compound.

Further experiments with sheep are now being started at Kopaki, where, in addition to pellet feeding, certain lick experiments will be tried. Pellets are also being fed to dairy cows in the malnutrition areas with the idea of increasing the butterfat yield.

Conclusion.

The writer regards the development of the pellet system of feeding minerals to stock as very important. It depends primarily on the fact that all animals are imitative and intensely curious, and that if a limited number of individuals can be taught to eat a new food the whole flock or herd will soon acquire the habit—with advantage to themselves and their owners. With proper machinery the proportion of the more expensive meals in the food can no doubt be reduced. The cost at present is therefore much higher than it will be when larger quantities are dealt with and greater efficiency in the manufacture is evolved. When it is considered that farmers are even now asked to pay £18 per ton for some manures, it appears that even £35* is not too much to pay for a ton of a food all the organic nutrients of which are easily digestible and of which the inorganic part is a mineral

* It is hoped to halve this figure eventually.

FIG. 3. LAMBS EATING NO. 1 PELLETS.

The lamb on right had been very sickly from birth, but was picking up at time photo taken.

FIG. 4. LAMB WITH PELLET IN MOUTH AT TROUGH.

[*Photos by C. M. Wright.*

manure, the greater portion eventually being redistributed on to the land in the dung and urine of the stock.

A ton of the pellets will be sufficient to treat a thousand sheep for over a month, allowing one pellet per day each. The experience of the Rowett Institute is that although some sheep may eat more than their share one day, the next they get less, so that the average is what is required to be given to each sheep. This is a great improvement on the lick treatment, which is difficult to contrive so that each animal will get a fair share, and also because some animals will never take the lick. The accompanying photos, especially Fig. 2, showing the sheep greedily searching for the pellets, indicate that there will be little difficulty in getting every animal to take them.

BLACKBERRY CONTROL BY GOATS.

STRIKING SUCCESS ON A HAWKE'S BAY STATION.

H. GUTHRIE-SMITH, Tutira Station, Hawke's Bay.

THE local origins of the blackberry in northern Hawke's Bay are Petane and Tangoio, where in the "seventies" hedges of this terrible weed had already been planted. On Tutira in 1882 there grew a few scattered plants, which, be it said to our credit, were there and then dug out; in fact, though neighbouring properties became gradually overrun, Tutira was practically clean of blackberry until the war.

Then, during the period between 1914 and 1919, certain areas on the station "got away." Owing to the shortage of men in New Zealand it was impossible longer to dig out the scattered bushes. These—in 1914 probably insignificant seedlings or actually not yet dropped by birds—increased both in numbers and size. By the end of the war they had possessed themselves of a valley or gorge facing south and of another locality facing east, the one of 150 acres, the other of double that extent. This country had mostly been under light bush.

When in 1919 I returned from the Old Country I was horrified and astounded at the state of the run. There were enormous blackberry bushes actually on the homestead lawn; there were 5-ft.-high thickets on the swamp lands, where blackberry had been unknown; on every eligible site individual thriving plants had established themselves. The two areas already mentioned had got far beyond the spade; ploughing or spraying with poison were alike impossible, because of landslips, limestone boulders, and dead timber.

Prior to the advent of goats the methods of defence adopted were digging, poisoning, ploughing, chipping, superphosphating, and salting. Of these digging is the least expensive and most satisfactory where only scattered bushes exist; indeed, even before the coming of the goats nine-tenths of the run had been thus cleared—a man having been put on with orders to the manager that nothing short of murder and arson was to call him off his job. The time taken in digging out a bush varies, of course, with the soil and situation, but the first work is the

heaviest. A blackberry bush 8 ft. by 8 ft. will take an expert eight hours; at a second handling of the soil half an hour; at the third, ten minutes. After that, until grassed over, two or three further inspections are necessary to pick out odd rootlets and seedlings. The great bulk of the hill country on Tutira is now clean, and was cleaned by spade and fork.

On the alluvial swamps, where dry enough, the largest patches were ploughed out—a comparatively easy task, for the roots on good soil do not penetrate deep; the bruising and tearing, moreover, of its root-system seems to hurt the plant more than the clean cutting of the spade. Elsewhere on the swamps poisoning with arsenic and weedkiller was the means employed. The difficulty was to get the poison at all seasons of the year to the spots required; the flat lands from time to time becoming impassable to horses, sledge, and barrel through continued wet weather, the plant badly crippled then obtained a new lease of life. The danger to stock, especially cattle, was, moreover, considerable. One tin from which perhaps a drop per hour of weedkiller had been escaping cost the station six bullocks. On another occasion I lost eight round a single newly sprayed bush. The smell of arsenic-withered leaves and tendrils attracts cattle from miles around.

I may say here that except to destroy the greenery I have found all such cures for blackberry absolutely worthless. Even greater waste of energy was chipping the young shoots as they appeared. The cost of salt and saltpetre was prohibitive—in the end it cost more than spade work. Superphosphating blackberry I have tried only as an interesting experiment, and when experience of goats had made me comparatively careless as to the result. Blackberry will get out of hand with sheep alone on land wintering five sheep to the acre, but whether sheep alone on superphosphated light hill soils would keep blackberry in check I do not know. If the land was sufficiently barren and miserable probably they would.

These various attempts at control were made elsewhere than on the main plaguespots—the patches of fallen bush already mentioned. There for several seasons gangs of Maoris were employed annually to cut the bushes level with the ground. This had the effect of metamorphosing the cone, into which in the open the natural bush develops, into a creeping star, the terminal bud of each ray rooting early in March. I have calculated that each season the blackberry thus cut—for in practice no scythe would get the flattest shoots—more than doubled its size. In the end, to make a long story short, the station was paying many hundreds of pounds a year in labour almost absolutely unproductive, the blackberry area was fast increasing, and the difficulty in obtaining men for this particularly distasteful job was getting more pronounced.

THE GOATS AND THEIR WORK.

I had heard of goats and the work done by them, but as in graver matters fear of the unknown makes us unwilling to test new methods, so for months I boggled over their purchase. However, goats finally were bought about seven years ago. Several of the small lots acquired were well-bred Angora; the others the very refuse of the race—terrible

looking brutes of every colour, size, and make. Year by year this unprepossessing herd has increased, only the best male Angora kids being retained as billies, and fast the flock is becoming white. We have now six hundred mature goats—an ample supply for our requirements—and this year got over two hundred kids. So far no attempt to utilize the fleece has been made, but at next docking the best will be roughly taken off and bagged.

Since arrival of the goats the annual cutting of the blackberry has altogether ceased. The bushes on the twin plague-spots—portions of 700-acre and 800-acre paddocks—are now browsed flat. At first some care was exercised in barking the goats back to these infested corners, but after a week or so the newcomers settled down, and since then have been left pretty much to their own devices. In summer they somewhat spread out to search for and devour the prickly tops of three or four species of thistle growing on the run; in autumn and winter they contract their range and confine themselves to a diet of hard thorny stems. I have reason to believe that during their summer excursions any outlying lawyer or blackberry discovered is never afterwards forgotten. No doubt the goats do take a certain amount of grass, but the area of land kept open by them and now also grazed by sheep more than makes up for the pasturage devoured. They prefer, in fact, blackberry, lawyer, and coarse hard herbage to the best grasses. I have known a mob pass over newly laid down grasses and clovers of two or three inches high—excellent sheep feed—to reach the roughest of herbage. Scattered blackberry bushes on the rich alluvial flats are more than held in hand; I have no doubt whatsoever that even blackberry in lucerne would be discovered and nibbled back. Certainly, too, goats eat much seedling manuka of an inch or so in height; they also trim the bigger bushes.

At first I did not care to see goats in every paddock, but nowadays we let them go where they like, sure that they can do no harm; and sure, too, that any seedling blackberry that may have escaped human eyes will never be allowed to grow more than an inch or so in height or spread. They are the police of this countryside; they arrest all sorts of vegetable ne'er-do-wells. We are glad to see them establishing themselves in paddock after paddock.

The success of the goat as a blackberry destroyer is the more remarkable in that—on Tutira at any rate—the most virulent and luxuriant growth of *Rubus fruticosus* is to be found on steep aspects, hillsides facing due south and therefore damp, cold, and almost sunless throughout the winter months. There, nevertheless, goats do most congregate, and there they have nibbled the bushes as box edgings are trimmed by garden shears. This means in practice that maybe by an inch or so a year the bushes in the most extremely wet places do enlarge themselves. Any big bush, however, thus increasing becomes also a mass of dead cane, and will burn readily in spring or during a spell of summer heat. It can then be blackened to ground level and the process on the weakening plant start again. So much is blackberry being hampered that I am beginning to think that on heavily goat-stocked land the plant may eventually altogether disappear.

So far there is a local demand for goats, but what eventual use will be made of the several hundred thousand that will be required permanently in this part of Hawke's Bay I know not. To shear them entails the risk of a cold snap, and goats are far less hardy than sheep. And although our flock spends the year roaming where they will, as the expression goes, "up to their eyes in feed," they do not show commensurate results in weight. I know of only one wether fat enough to kill, and some of the Toggenburg and Anglo-Nubian crosses are very greyhounds in their lenten leanness. I confess, however, that neither shearing nor fattening have been much in mind—we have been content to regard goats as mere animated scythes. They give no trouble in mustering; except at docking-time, the mixed mob of sheep and goats is given a few minutes at gateways when they separate themselves naturally—the goats being allowed to draw off and return to their good work. So far, in a climate of 55½ in. average rainfall, no foot-rot among goats has troubled us.

CONCLUSION.

To reiterate: Since the stocking of Tutira with goats at the rate of 60 per 1,000 sheep scything and poisoning of blackberry have altogether and absolutely ceased. Spade work, too, has been stopped in paddock after paddock; now, indeed, it is practised only in the hedges and plantations of the policies, where, however, already the number of seedlings brought by birds is sensibly diminishing. The 6 per cent. of goats carried has made no difference in the feed available for sheep. In paddocks of six and seven hundred acres goats work the blackberry areas without shepherding. During the winter months goats crowd on to the cold wet steep sunless southern slopes. Goats are reasonably amenable; they give no trouble in mustering, and stay put to a much greater extent than would appear probable from their known activity. They do jump fences and they do straggle, but when brought back they remain. At the worst they are no worse than Merinos; indeed, in my recollections they are less restless and wild than this breed of sheep. Nor must it be thought that only large areas of ground can satisfactorily be treated with goats. Several of the settlers in this neighbourhood on 800- and 1,200-acre farms are making a good job of the pest, and so flattening to the earth the horrid cone-shaped excrescences that the countryside is in appearance improved out of all knowledge. Sections that have until lately been regarded as practically worthless will again support settlers.

The stocking of Tutira with goats to the extent of 60 per 1,000 sheep has been in my estimation an unqualified success. I do not see how this method of blackberry control can be bettered.

Importation of Animal-manures from Australia.—An Order in Council gazetted on 13th December, 1928, prohibits the introduction into New Zealand of animal-manures from the Commonwealth. This follows the recent withdrawal from Australia of the Agriculture Department's system of inspection, consequent on the gradual shrinkage of the trade to very small proportions. The trade in the past was principally in bonedust, ample supplies of which are now manufactured within New Zealand.

SOME PASTURE TOP-DRESSING RESULTS IN WELLINGTON PROVINCE.

R. A. Wilson, D.S.O., Marton.

A remark made by a Rangitikei farmer that "top-dressing has revolutionized farming in the district and has altered nearly all our preconceived ideas and practices, and we are only just beginning to learn our farming afresh," sounds an exaggerated statement when first heard. Consideration will show, however, that the revolution which is being accomplished is so striking in its results that there is much truth in the remark.

The basic reason for the rapid extension of top-dressing is the high value of the return obtained compared with the cost of the fertilizer and labour used to produce it. The figures as quoted later (ignoring the value of the by-products such as wool and the cost of application) show that one farmer has increased his annual production of fat lambs by about 700 by applying annually 30 tons of superphosphate. This, at £5 a ton for the super and 25s. a head for the fat lamb, means that a return of £875 has been secured at a cost of £150. To put it another way, an increase of 700 lambs has been secured at the cost of 120, or about 17 per cent. of the return. Looking at it in yet another way, it has taken about 30 tons of manure at £5 a ton to produce about 11 tons of lamb selling at £75 or £80 a ton.

On my dairy farm at Himatangi the figures as quoted later show that an application of 15 tons of manure annually has produced an increase per annum of about 4 tons of butterfat, which sells at the the present time at about £150 a ton. This is about the same proportional result in weight as just given for fat lambs.

In the case of wool, however, the profit would not be nearly as great, as, though it sells at a high price per ton, the amount of manure required to produce a ton of wool is much greater than with lambs or butterfat. Any fall in price, of course, in fat lambs or butterfat would decrease the profit commensurately. When fat lambs were first put on the market in this district about twenty years ago their value was not more than 10s. per head, and though a profit on top-dressing could be shown even at this figure it would not be nearly so great as under present values. Assuming the cost of manure to be the same, it would take 300 of the increase to pay for the manure, or about 43 per cent. of the return, if lambs sold at 10s. each.

The above figures are, of course, not meant to show that a net profit of these surpluses of return over expenditure is being made. In the case of fat lambs there is the cost of the ewe to be considered, and in the case of the dairy cow the labour of milking to be provided for, and before a balance could be struck in either case many other factors would have to be allowed for. These considerations do not, however, affect the main issue—namely, that top-dressing is profitable.

I am able to give (Table 1) some data from a Marton farm on heavy clay land with an area of 490 acres for the years 1921 onwards, when top-dressing was commenced. In 1921 about 100 acres were

under grain crop, while in 1928 the area had dwindled to about 40 acres under wheat and oats and 20 acres in swedes. The figures represent the number of ewes wintered on the property, and every year over 100 per cent. of lambs have been reared and fattened. The total number of fat lambs sold is not given, as different lots of lambs were bought in and fattened occasionally, which would vitiate the comparison.

Table 1.

	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.
Ewes wintered ..	630	653	950	1,000	1,050	1,200	1,300	1,532
Tons manure used ..	Nil	12	11¼	19½	22½	24½	29½	37¼
Cost of manure ..	..	£115	£85	£141	£154	£156	£132	£196
Increase in ewes wintered ..		23	320	370	420	570	670	902

Except for 1922 the great bulk of the manure used has been 44–46 per cent. superphosphate. During this period also draining has been proceeded with, though not on a very extensive scale.

This table brings out a fact which is being recognized more each year—namely, that the effects of top-dressing with phosphates are cumulative. Though the quantities of manure used have increased, it will be recognized it would have been quite impossible to winter 900 more ewes in 1922 even if the amount of 37¼ tons applied in 1928 had been used. There also has been such a steady increase that there is nothing to suggest that the limit of carrying-capacity has been reached under the system.

Some particulars for my own dairy farm at Himatangi will now be given. I started dairying in 1921 with a herd of twenty-five heifers. The herd, which is grade Friesian, has been running on practically the same area all the time, but more land has been brought in as the lake which borders the property has been lowered by draining. Probably the land grazed over by the herd has increased from about 110 acres to its present area of about 150 acres, and I estimate that without top-dressing the area would produce between 5,000 lb. and 6,000 lb. butterfat per year. This is a light sandy soil with the water-level close to the surface, which in a dry season helps considerably to keep the pastures green. Until top-dressing was applied it was looked on as poor land unfit for dairying.

The following analysis of the soil by the Chief Chemist, Department of Agriculture, shows the mineral content calculated on the moisture-free sample :—

Table 2.

Location.	Volatile Matter on Ignition.	Total Nitrogen.	Lime (CaO).	Magnesia (MgO).	Potash (K_2O).	Phosphoric Acid (P_2O_5).
			1 per cent. Citric-acid Extract.			
Lot No. W. 1379, Himatangi	3·1	0·075	1·155	0·052	0·016	0·003
			Hydrochloric-acid Extract.			
	..	..	3·41	0·69	0·35	0·01

This brings out clearly the phosphate deficiency and explains the response which the land gives to phosphatic top-dressing. There is a large area of sandy soil round Himatangi which shows a similar response, and some remarkable figures for top-dressed farms have been obtained in the locality. For example, Mr. Shailer's herd under herd-testing conditions has shown an average return of over 400 lb. per cow for two years, the figures being 410 lb. and 394 lb. respectively.

The figures for my farm are as under :—

Table 3.

—	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.
Number of cows milked	25	35	44	51	54	60	70
Tons manure used ..	..	5	7	Nil	12	18	20
Cost of manure ..	..	£35	£46	Nil	£75	£83	£100
Pounds butterfat produced	3,000	5,048	8,657	9,617	13,065	15,972	..
Average factory return per cow (pounds butterfat)	120	144	196	188	242	266	..
Average price per pound	1s. 6d.	1s. 5d.	1s. 6d.	1s. 5d.	1s. 3d.	1s. 6d.	..
Total return ..	£223	£356	£633	£666	£820	£1,197	..

Here is seen again the cumulative effect of the top-dressing, and here again the steady increase suggests further progress. It will be noted that this season seventy cows are being milked. The average return per cow has steadily increased, except in the season 1925–26, when no top-dressing was done. The slowing-down of the increase that year is also noticeable. The manure used has been mostly half super and half Nauru phosphate. If no Nauru had been used probably a still more noticeable lag would have been shown for the year in which no top-dressing was done.

One of the most remarkable effects of the top-dressing has been the complete change in the composition of the pasture. About one-third of the area was ploughed and laid down to English grasses, but the remainder when dairying commenced was chiefly weeds and sedges, being the natural growth that sprang up when the lake was drained. A portion was top-dressed as an experiment, and the results were so good that the whole of the area was top-dressed annually. The weeds and sedges have now given way to a thick growth of clovers consisting of white clover, strawberry clover, Lotus major, suckling clover, and trefoil or *Medicago lupulina*. A few pounds of Lotus major and a very small quantity of strawberry clover had been sown on the edge of the lake some years previously, but were not very noticeable. With top-dressing they both increased very rapidly, and, though sometimes covered with water in winter, these two form a complete mat in the wetter places and give a splendid lot of feed in the autumn when the pasture on the drier portion is going off. This self-sown area is now too good a pasture to plough up. The only drawback is that as there are few grasses in the pasture it does not come away very early in the spring and probably is not so balanced a ration as the paddocks sown down to English grasses, which have also steadily improved each year.

Following also are some figures of the returns from a dairy herd milking on a property of about 170 acres at Rangataua, on the Main Trunk line. This district has a cold winter and a short dairying season, and returns are consequently much lower than at Himatangi, though they can doubtless be increased by consistent top-dressing. The farm is on a light volcanic soil about ten years out of bush, and showing signs of deterioration.

Table 4.

——	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.
Number of cows milked ..	26*	33	29	40	40	50
Tons manure used ..	..	..	3	3	7½	12
Cost of manure	..	..	£19	£18	£35	£60
Pounds of butterfat produced	3,000	3,697	3,799	6,041	6,165	..
Average pounds per cow ..	115	112	131	151	154	..
Average price per pound ..	1s. 4d.	1s. 4d.	1s. 5½d.	1s. 2⅓d.	1s. 4d.	..
Total return	£199	£246	£277	£364	£410	..

* Heifers.

The top-dressing here, which has been mostly with superphosphate, has not been under way long enough to judge of the full effect; but the response is marked, and the extra return has repaid the cost of the manure several times over. Here also the return per cow is going up, and with steady manuring a cumulative effect may be expected.

I have not included the cost of application in the foregoing comparisons, since in each case the manure was applied by the ordinary labour of the farm and the cost is difficult to estimate correctly as a basis of comparison. However, it may be said that on level, easy country the manure should be applied by a distributor at a cost of 1s. 3d. to 1s. 6d. per acre. When sown by hand, contract labour will undertake the work in hilly country at from 2s. to 2s. 6d. per acre, according to the amount sown; the usual price is 17s. 6d. to £1 per ton when the manure is packed over to convenient points for the sower to reach. The packing by horses would probably run about 5s. to 10s. extra per ton, according to the distance from the delivery-point by road. In sheep-country at a distance from the railway, however, the carting by road is often more expensive than the packing and sowing, as if the farm is distant—say, fifteen to twenty miles—the carting may cost up to £3 a ton, though sometimes when back loading can be arranged it may be done for £2 a ton. On country easily reached by motor-lorry and a few miles from the rail the carriage would not cost, of course, more than 7s. 6d. to 10s. per ton.

The three instances given of three different types of soil in localities widely separated, all show remarkable response to phosphates, and it may be said that any one dairying or growing fat lambs in this province is losing money if he does not top-dress his pastures. Some farmers say they cannot afford to top-dress, but this shows a want of clear thinking, as they really cannot afford *not* to top-dress. The return from dairying or fat lambs is so immediate that every farmer, unless he is in a very unsound financial position, can obtain credit for manure for the short period before it pays for itself.

DISTEMPER IN DOGS.

RECENT RESEARCH WORK ON IMMUNIZATION.

Lecturette by D. A. GILL, M.R.C.V.S., D.V.S.M., Assistant Officer in Charge, Wallaceville Veterinary Laboratory, broadcast from Radio Station 2YA, Wellington, November, 1928.

DISTEMPER, which is one of the most widespread as well as the most devastating diseases affecting dogs, has carried off a great many victims in this country. Besides the distress caused by the loss of pets, it has hit a good many farmers very heavily in robbing them of dogs which cost a considerable amount in the first place and on which much time and labour had been spent in suitable training. On many sheep-stations about two years ago, when there was an unusually large amount of distemper about, almost all the dogs on the place died of it.

My main purpose is to tell something of the research work that has been done in the last few years on distemper, of the excellent progress that has been made, and of the great hopes we have of being in a position to immunize dogs against the disease and so prevent these losses. Some five years ago *The Field*, a weekly paper in the Old Country, opened a subscription list called *The Field* Distemper Research Fund, with the object of getting a sufficiently large sum of money to thoroughly investigate the matter. The actual research work has been carried out by Dunkin and Laidlaw, the former a veterinary surgeon and the latter a medical man.

Their first job was to obtain a kennel of dogs that were absolutely free of distemper, and this was a matter of great difficulty. Special kennels had to be built in which dogs could be bred without contact in any way with the outside world, so that the investigators would know that their experimental animals were free from the disease and therefore susceptible to it. Just how necessary that was, and how rigid are the precautions taken to avoid infection being accidentally introduced to the premises, may be imagined from the fact that not only are visitors strictly limited, but that every one entering has to go through three rooms. In the first room they undress, in the second they have a bath, and in the third they put on sterilized clothes. When a dog is required to be infected it is removed from the clean kennels to a separate establishment elsewhere in the grounds.

At the time the work was started there were two recognized opinions as to the cause of distemper. One was that it is due to a germ that could generally be found in the windpipe and other parts of affected dogs; the other that it is caused by what is known as a filterable virus—that is, an infecting agent so small that not only is it invisible with the most powerful microscope, but it will pass through a filter which is fine enough to hold back all visible bacteria. The first thing, then, was to find out which of these views was the correct one; and the work that was done showed, beyond any reasonable doubt, that distemper is in fact due to a filter-passing virus, and not to the germ found in the windpipe, &c.

A fact which came to light early in the work, and which is of the greatest importance to the spread of the disease among sporting dogs,

was that ferrets are also liable to distemper, and the disease can be, and frequently is, transmitted from dog to ferret and from ferret to dog. That this was so had been suspected for some time, and once it was verified the investigators made use of ferrets for much of their experimental work, since a stock of ferrets is not only cheaper and easier to maintain, but they can be kept healthy in much closer quarters than dogs, and therefore can be guarded from chance infection more easily.

To give the details of the work carried out would be a very lengthy business and perhaps not very interesting to the layman, so I will make the account as brief as possible. Working with ferrets it was found that the virus or infecting agent was present in the greatest amount in the spleen of affected animals in the early stage of the disease, which is accompanied by high fever. Now, it is a well-known fact that once a dog has had distemper and recovered he is immune from further attacks for a very long time, if not for life ; and once it was definitely known where the virus was to be found, and that by giving a dog or ferret a dose of it an attack of the disease could be produced, the crux of the investigation was reached. That is, it now became a straight-out question as to whether or not it was possible to give an animal a dose of virus which, while too small to cause disease, was nevertheless enough to produce immunity, or whether by using virus which had been killed by some artificial means the same effect could be produced. Although it has not taken long to give you this brief account of their work, the actual time taken by Dunkin and Laidlaw to reach this stage was about three years, and one can imagine what great disappointment would have been theirs had they found after so much carefully conducted work that artificial immunization could not be done.

A method of artificial immunization was tried out in the first place on ferrets, and in the investigators' hands was about 90 per cent. efficient. Now, as there is a considerably higher death-rate from distemper among ferrets than there is among dogs, it would be reasonable to suppose that if the vaccine used could be modified so as to be suitable for dogs it would be even more than 90 per cent. efficient in their case, and from experiments on dogs that have since been carried out it appears that this may very soon be an established fact.

The preparation of the vaccine is as yet in the rough, as it were, but the path to complete success has been pretty clearly indicated through the work already done. An endeavour is now being made to initiate similar work at the Wallaceville Veterinary Laboratory, so that here in New Zealand we may be in a position to test the methods that Dunkin and Laidlaw have discovered, and as soon as possible to place our dog-owners in the happy position of being able to immunize their dogs against distemper with confidence and certainty. It promises very strongly to become one of the greatest advances in veterinary science for some years, and the veterinary profession and dog-lovers all over the world owe their sincere appreciation not only to Dunkin and Laidlaw, whose brains and work have placed the matter on such a substantial footing, but also to *The Field*, which has raised the large sum of money that was required before the investigation could be properly carried out.

I would like to point out that there are many different diseases, both of man and animals, that are due, like distemper, to filterable

viruses, and since very little indeed has so far been found out about them, owing to the great difficulty of studying such things, this detailed and laborious work on the virus which causes distemper in dogs will probably have far-reaching results on our knowledge of the other diseases, such as foot-and-mouth disease of animals and infantile paralysis of human beings, which are due to infecting agents of the same class. Consequently the medical as well as the veterinary profession, and through them the public, are likely to benefit in many matters which to the layman appear very far removed from distemper.

PRACTICAL HINTS ON TREATMENT.

A few hints on the ordinary treatment of distemper may be given in the meanwhile. The disease attacks dogs generally in the first year of life; sometimes later, but seldom after two years old. After an incubation period of about ten days there is dullness and generally running at the eyes and nose. For the first day or two there is fairly high fever, after which the temperature generally falls and the dog appears much better, and the owner is very much inclined to think he is all right again and not bother any more about it. This is just where much of the trouble crops up, because in spite of appearances the dog is not over the attack by any means at that stage. The temperature rises again—not so high as at first, but quite enough to predispose the dog to pneumonia and other complications if he is not taken care of. This second rise of temperature lasts for two or three weeks, and great care must be taken of the patient until it finally falls to normal and remains there.

Aspirin in 5- or 10-grain doses once or twice a day, according to the severity of the attack and the size of the dog, is about the best drug for pulling down the temperature. The dog should be kept warm and comfortable, and exercise or any sort of work or excitement must be avoided. Under these circumstances constipation is apt to occur, and a small daily dose of medicinal paraffin is excellent to ward this off. As to diet, the best is the dog's natural food—raw meat; but he should not be *suddenly* changed on to this sort of food if he has been accustomed to other things. If diarrhœa occurs, as it is very apt to do in this disease, boiled milk, arrowroot, &c., are more desirable. About the best tonic to give is cod-liver oil, which is readily taken with the other food, so that, besides its undoubted value, it is no trouble, and the dog is not worried by constantly being given medicine.

A very important thing to remember is that distemper is *extremely* contagious. That point has been left till last in order to impress it more strongly. A dog with distemper that is allowed to roam about or is taken out for walks, will very soon infect all the dogs about the place that have not already had it. So for the sake of neighbours, as well as in your own dog's interest, if he shows any signs of the disease shut him up by himself. Do not handle him more than is necessary, and when you must do so wash thoroughly after it, as infection is only too easily carried on the hands and clothes. Do not let the dog mix with other dogs till he has been normal for several days, and when the trouble is over disinfect the place he has been in and burn his bedding.

Good nursing will do a great deal for any case of distemper, but where veterinary aid is available it should be sought, as there is perhaps no other disease in which so many different complications requiring special treatment may crop up.

Let us hope that before very long, as a result of the research work that is being conducted, distemper will become a thing of the past.

NOTE.—Since this lecturette was broadcast cabled messages from Britain have been published in the newspapers indicating that results have largely borne out the promise which the experimental work of Dunkin and Laidlaw held out. The Department of Agriculture has cabled for the fullest available information.

PREVENTION AND TREATMENT OF MAMMITIS IN DAIRY COWS.

Live-stock Division.

CONTAGIOUS mammitis causes much loss to dairy-farmers every season, and in order to minimize it as much as possible it is necessary that the greatest care be exercised in observing all precautionary and preventive measures, and also in applying proper treatment when cases have arisen.

It must always be kept in mind that the udder of the cow is made up of extremely delicate tissues, and, especially when in full milk, is extremely sensitive to any deleterious influences to which it may be subjected. When a cow is living under natural conditions, suckling her own calf, the milk is drawn by the calf in moderate quantities at frequent intervals, and the udder is not subjected to the process of alternate distension and complete emptying-out which occur immediately before and at the end of each milking under necessary dairy-farm conditions, and which in themselves increase its sensitiveness and its liability to trouble when subjected or exposed to any injurious influences. Among such influences may be enumerated the following :—

(1) Direct infection by the streptococcus of contagious mammitis.

(2) Temporary ill-health of the animal due to digestive or other trouble.

(3) Improper operation of the milking-machine, such as running it at too high pressure, leaving on after the udder has been milked out, uncleanliness, &c.

(4) Severe chills, which may be incurred in various ways, as, for instance, washing the udder with cold water on a cold day and not drying it immediately with gentle friction ; contact of a portion of the udder, when large and pendulous, with cold wet ground, or with a frosted ground surface, when the animal is lying down.

(5) Temporary overstocking of the udder.

(6) Uncleanly conditions in and about milking-shed and yards.

(7) Allowing dogs to hurry cows to the milking-shed.

Dairy-farmers should use every effort to prevent their cows being subjected to any of these influences. They cannot, of course, help weather conditions, and temporary ill health may occur in spite of the

best attention, but by the exercise of all possible care in the handling of the cows, in the use of milking-machines, and in the maintenance of cleanliness, many cases can be avoided.

PREVENTION.

Much time and much scientific effort have been devoted to the endeavour to find a thoroughly reliable preventive treatment for mammitis in the form of a vaccine or a serum, and if such a preparation could be found it would be a great boon to dairy-farmers. But so far no vaccine has been discovered which can be relied upon as being effective. Vaccine treatment has been given an extensive trial in New Zealand, but it has failed to give the results which had been claimed for it. This is in accordance with the experience of scientists dealing with both human and animal disease, who have found that, as regards diseases associated with infection of the type found in mammitis, vaccine treatment has not proved reliable, though endeavours to produce reliable vaccines have been in progress in all civilized countries for several years past. Nevertheless, research in this direction is still in progress, not only abroad but in New Zealand also.

It must be realized, therefore, that the utmost importance is attached to all possible precautionary measures which can be carried out by the farmer himself. These may be briefly summarized as follows :—

(1) Practise rigid cleanliness in all things. Pay particular attention to milking-machines and teat-cups. Keep leg-ropes as clean as possible.

(2) See that the machines are running at the proper pressure and not too high ; that they are not left on too long ; and that all parts are kept thoroughly clean.

(3) Every cow affected with mammitis must be regarded as a possible centre from which infection may be spread to other cows in the herd. Therefore, any cow known or suspected to have anything wrong with its udder must be kept back until all the others have been milked, and then be milked carefully by hand, the milker's hands being well disinfected immediately after handling of the cow has ceased.

(4) Never strip an affected quarter on to the ground—always into a receptacle containing disinfectant.

(5) The early detection of mammitis cases is of the utmost importance, both from the preventive and curative points of view. This is best done by taking a strip or two of the fore milk from each quarter before putting the machines on. Take these strips into a bucket the top of which is covered with fine wire gauze. Any small clots in the fore milk are then immediately detected, and a cow whose milk contains them must be regarded as a case of mammitis and treated accordingly.

(6) When a cow has apparently recovered from an attack, do not at once put the machines on her. Continue to milk by hand for two or three weeks, so that any possible remaining infection may not have an opportunity of being spread to other cows by the agency of the machine cups. In such cases it is a wise precaution to take samples of the milk from the quarters involved, send them to the Wallaceville Veterinary Laboratory for examination, and obtain a report before commencing the use of the machine.

TREATMENT.

When mammitis occurs, a great deal of benefit and a number of recoveries can be brought about by relatively simple methods of treatment, if *carefully* and properly carried out. They involve the expenditure of some time and trouble, but they are well worth adoption.

A good practice is at once to give the affected cow a dose of laxative medicine. A useful mixture to give is 10 oz. of Epsom salts, 2 drams of powdered nitre, and 2 drams of powdered carraway-seeds, administered in 1¼ pints of warm water or, preferably, very thin gruel. In severe cases, after the laxative effect of this drench has passed off, the cow can be given 4 oz. of Epsom salts dissolved in ½ pint of warm water or thin warm gruel, once daily for three or four days.

Apart from this medicinal treatment, the following measures should be adopted :—

(1) Stripping : A most important feature of treatment is *frequent stripping*. This reduces the invading army of germs, and also removes the tissue-damaging substances which they produce ; moreover, by keeping the affected quarter as empty of milk as possible the germs will be deprived of much of their food-supply. Stripping should be done at frequent intervals—the oftener the better. Even if stripping could be done every two hours it would not be too often—in fact, it would be very advantageous.

(2) Massage : This should be done thoroughly but gently, from above downwards towards the teat. Do it after stripping. Olive-oil, or some simple harmless lubricant, must be used to prevent chafing the skin when massaging. It is a good plan to mix liquid extract of belladonna with the oil in the proportion of one part to four parts of oil. When this is done, again strip out the milk that massaging has brought into the milk-cistern.

(3) Fomentation : This is particularly helpful in severe cases, especially in the early stages. It is best done by applying a flannel wrung out in hot water, keeping the water hot throughout. Not less than half an hour should be spent in doing this. Afterwards rub in some olive-oil, preferably with one part of liquid extract of belladonna added to each four parts of oil. This will counteract the effects of cold after the fomentation (which is very important). In severe cases avoid turning the cow out if the weather is bad or there is no sheltered place to put her in. Foment thrice daily while the quarter is hot and swollen.

Iron Treatment for Bush Sickness.—In a recent report Mr. C. M. Wright, Country Analyst under the mineral content of pastures investigation, relates a settler's experience as follows : " A farmer on the coastal pumice lands (Bay of Plenty) who is milking 130 cows on 200 acres was recently visited. He told me that his neighbours over the fence were farming on the same lines as himself, except that he put the iron-ammonium citrate as recommended in the drinking-water for his cows. He states that his cows average 8 lb. of butterfat per month more than his neighbours, and he is sure that the result is from the use of the citrate. He also feeds the drug in skim-milk to his calves, and now rears good ones, whereas before using it he had difficulty in doing so. One of the paddocks is on the reclaimed swamp, but the rest of the farm can only be a few feet above it.

NORTHERN WAIROA EXPERIMENTAL AND DEMONSTRATION FARM.

NOTES ON OPERATIONS IN 1927–28.*

THE season of 1927–28 commenced well throughout North Auckland with a mild and warm spring and plenty of growth. Towards the end of September, however, cold winds and squalls were experienced, followed by dry conditions, which continued, more particularly on the western coast, until well into the following March. The autumn recovery of the pastures was too late to be of real benefit to the milking-cows as regards yield.

PASTURES.

During the year further marked improvement has been shown in all the top-dressed pastures, which stood up remarkably well to the dry conditions until the beginning of February. The proportion of pasture in which paspalum is well established has been increased from practically nil to some 20 acres, and in the mixture for a further 12 acres of young pasture paspalum-seed has been included, though in the case of 6 acres sown in the autumn of 1927 very little paspalum is to be seen as yet. The fact that paspalum tends to increase under the conditions prevailing on the farm, where the rye-grass pastures open up during summer, is clearly shown by the gradual spread of the former grass through the older top-dressed and heavily grazed pastures where no paspalum-seed was originally sown, but was later introduced by stock.

The experience on the farm bears out the assertion that, by continuous top-dressing and good management, pastures which are predominantly rye-grass in the early spring and paspalum-white-clover-dominant during the summer can be maintained and are very desirable. The increase in the proportion of paspalum in the older purely rye-grass pastures is therefore looked on with favour, and steps will be taken as soon as possible, through the feeding-out of paspalum hay, to speed up the process with a view to establishing over the whole farm rye-grass, paspalum, and white clover pastures, with such grasses of the original sowings as timothy and meadow foxtail taking a minor part.

PASTURE TOP-DRESSING.

The funds available for top-dressing are directly dependent on the returns from the dairy herd, and it was hoped that the 1927–28 season would see an extension of experimental top-dressing, combined with further subdivision and the inauguration of an intensive rotational system of pasture grazing. Owing, however, to the prevalence of mammitis in the herd, and the lateness of calving of the majority of the cows due to the difficulty experienced in the previous season in getting them in calf, the top-dressing programme was necessarily restricted to a continuation of that of the previous year. An area of 66 acres was top-dressed at the rate of 3 cwt. of straight phosphate

* An article on the establishment and first two years' working of this subsidized farm was published in the *Journal* for January, 1928.

per acre, 33 acres receiving basic slag and a like area superphosphate. The chief point of interest in regard to the top-dressing results is the relatively greater improvement shown in the supered paddocks. In the first two years those paddocks top-dressed with 3 cwt. per acre of basic slag showed a much better response than those dressed with the same quantity of super. During the season under review the supered pastures showed up to advantage more in the growth of rye-grass, though the slagged paddocks are still preferred by the cows, due mainly to the better growth of white clover and generally shorter and thicker sward. The difference in the sward is particularly indicated by the persistence of pennyroyal and buttercup in the supered paddocks, whereas both these weeds have been almost completely crowded out by the better growth of white clover in those paddocks dressed with slag.

FIG. 1. PORTION OF THE IMPROVED PASTURES.
Tripod-harrowed area seen in middle distance.

FIG. 2. PART OF UNDEVELOPED AREA OF THE FARM.

SUPPLEMENTARY CROPS.

Very definite periods of shortage in pasture-production are experienced on the farm in dry summers and during winter and early spring. The aim is to eventually provide for these periods by an increase in the proportion of paspalum and the conservation of excess spring and early summer pasture growth in the form of silage and hay. This provision is contingent on an extension of top-dressing (including special nitrogenous top-dressing), the introduction of more paspalum, better drainage, closer subdivision, and intensive rotational grazing on that portion of the farm already brought into fair pasture by the top-dressing already carried out. In the meantime crops such as soft turnips, swedes, and mangolds have been depended on to provide for the periods of shortage.

The entire failure of 4 acres of soft turnips and swedes after repeated sowings, owing to the sudden drying-out of the ground in October (1927), was reflected in the rapid decline in butterfat-production from January on. The mangolds, though standing up to the dry conditions better, also suffered from lack of sufficient moisture, and little growth was made by them until the autumn, resulting in a light crop, which, however, was very valuable for the early calvers. On land such as that represented by the farm the farmer is very dependent on weather conditions in growing root crops, unless extensive and costly underground drainage is carried out or he is fortunate in having a naturally well-drained paddock available. The failure of the crops referred to and the drying-out of the rye-grass pastures demonstrated once more the importance of paspalum and the necessity for conservation of the excess early summer growth, especially in the form of silage.

THE DAIRY HERD.

Though the pastures have been improved to a wonderful extent by top-dressing, tripod harrowing, and drainage, and the feed available definitely increased, the real stumbling-block in the progress of the farm has been the dairy herd. That the cows are capable of high butterfat-production is evidenced by the returns from those cows which have regularly come to profit early and have not suffered from mammitis. The average for the July and August calvers, which are representative of the rest of the herd, is well over 300 lb. of butterfat, whereas the average for the whole herd of twenty-six cows and sixteen heifers was just over 200 lb. in 220 days. A large proportion of the heifers necessary for replacements in the herd on account of disease were undoubtedly capable of much higher average production, but were more affected than the cows by late calving, followed by dry conditions. Despite the best efforts of the manager, together with the assistance of Live-stock Division officers, the trouble in regard to getting the cows in calf persisted, as also did the prevalence of mammitis, some twenty-five of the herd having suffered from this disease during the season under review. By the end of October only seventeen of a herd of forty-two cows and heifers were in milk, and the majority of the herd came to profit while the pastures were falling off under the dry conditions prevailing.

The value of top-dressing was demonstrated not so much by an increase in carrying-capacity, but rather by the fact that despite the

total failure of the soft turnips intended for use in January, February, and March, and the short milking season of the majority of the cows, together with the exceptionally dry summer, the production of butter-fat was some 400 lb. ahead of that of the preceding year, when there was good provision of soft turnips and a good summer rainfall.

FIG. 3. FIELD-DAY DEMONSTRATION OF PASTURE HARROWS.

FUTURE WORK.

The future progress of the farm is of course dependent on production from the herd, and while this remains almost stationary, as it has done despite increased carrying-capacity during the past three seasons, this progress must be slow. The policy for the season of 1928–29 is a concentration on the lines already mentioned in the further development of the area so far brought into fairly good pasture. In this connection subdivision and rotational grazing will play an important part, and the effects of frequent tripod harrowing after each grazing will be noted. Provision has also been made for a definite reduction in the area under crops by an extension of hay-production and the introduction of ensilage-making.

—C. J. Hamblyn, B.Ag., Instructor in Agriculture, Whangarei.

Loss of Lime or Plant-food from Soils.—" In New Zealand no data are available concerning the loss of lime or plant-food from different soils under various conditions of rainfall," states Mr. T. Rigg in the course of a report on the Washington International Soil Congress. " In the past, agriculturalists have been apt to take the data obtained at such stations as the Rothamsted Station as applying directly to New Zealand conditions. The work of Professor Hendrick at Aberdeen, and of Professor Robinson in Wales, has shown that the loss of lime and phosphate from their soils differs widely from those of Hertfordshire soils. Similar data in connection with the loss of lime and plant-food from New Zealand soils are urgently required in order that liming and top-dressing of soils may be put on a satisfactory basis."

HON. G. W. FORBES, M.P.,

MINISTER OF AGRICULTURE IN THE WARD MINISTRY.

Mr. Forbes is also Miinister of Lands, and Minister in Charge of Land for Settlements, Scenery Preservation, Discharged Soldiers Settlement, and Valuation Department. The Ministry assumed office on 10th December, 1928.

CONTROL OF FIREBLIGHT IN THE ORCHARD.

HINTS TO FRUITGROWERS.

J. A. CAMPBELL, Director, Horticulture Division.

WHENEVER suitable opportunity has offered during the past two or three years fruitgrowers have been given to understand that fireblight would eventually have to be dealt with by the Department of Agriculture on practically the same lines as other diseases affecting orchards, but much more stringently, owing to the disastrous effects which neglect on the part of any fruitgrower might have with respect to the whole district concerned. There is a tendency to look to the Department to assume responsibility for the suppression of an outbreak, and in some measure blame its officers for any failure to suppress, whereas the blame could more equitably be laid on the careless orchardist. Individual effort on the part of growers is the keynote of control, and recent legislation enables them to apply co-operative effort more fully than was possible in the past. The course of procedure is briefly outlined in the matter which follows.

Each season in regard to fireblight may be deemed to commence with the blossoming period of fruit-trees, and any hold-over canker discovered at this time should be regarded as a canker from the previous season. While the cutting out of infections that occurred during the blossoming-period and later is highly desirable, and should be attended to as thoroughly as circumstances permit, the damage arising from such infections is largely confined to the particular orchard in which they exist.

The disease during this period is to a large extent spread by means of chewing-insects, which, although they may carry it to a nearby orchard, largely operate and spread the disease within the original orchard where it exists. This fact does not mean that reasonable work in cutting out infection should not be carried on. The right to insist on this work being done, within reason, cannot be foregone. Compulsion in extreme cases, in the form of prosecution, may be deferred till later, but orchardists must understand that the control of fireblight is their responsibility, while the Department's officers operate more as inspectors to ascertain how thoroughly the work is being done, and when the necessity arises to take action.

Apart from what may be insisted upon by the Department in the cutting-out and checking of the disease during the summer and early autumn, a definite date has been fixed after which the finding of hold-over cankers in an orchard would involve prosecution — namely, 31st July. By this date orchardists will have carried out the major portion of their pruning, which operation affords an excellent opportunity for the search and removal of cankers. It is physically impossible for our officers to make a personal inspection of every tree and practically every limb of every tree in their districts. The only hope of keeping a locality free of fireblight is that growers will make this individual tree-inspection and do the cutting-out of all classes of cankers. By means of general inspection visits by officers, and more particular

inspection where it is suspected that a grower has not been quite thorough, the efforts of the careful orchardists will be safeguarded.

The foregoing procedure in its entirety can, of course, only be applied to those districts in which hawthorn hedges have been removed or otherwise satisfactorily attended to. In localities where fireblight is present and no commercial fruitgrowing area has been declared by regulation the disease will be mainly dealt with as an ordinary orchard disease.

THE UTILIZATION OF WHEY.

ECONOMICS AND TECHNIQUE OF CONCENTRATION.

M. A. F. Barnett, M.Sc., Ph.D., Physicist, Research Department, Wellington, in the *New Zealand Journal of Science and Technology*.

In England the problem of the utilization of whey became one of very great importance not so much because of any economic wastage, but because the disposal of the unwanted whey presents the greatest difficulty, due to the nuisance produced when it is discharged into sewers or streams, &c.

In New Zealand this latter aspect is not of such grave importance, but from the economic point of view an investigation is obviously warranted which might lead to a profitable utilization of the enormous quantities of whey at present going to waste. Based on the production figures for cheese, the total annual output of whey in New Zealand is about 600,000 tons, and of this quantity about 42 per cent. is produced in the Taranaki District, 16 per cent. in Wellington, 15½ per cent. in Southland, and 14 per cent. in the Auckland Province. If, for illustration, we assume that this whey is worth a farthing per gallon, the value of the annual output for New Zealand is about £140,000.

A certain proportion of the whey produced is already used for feeding direct to pigs, but there are some important drawbacks to this practice. In the first place, whey is so dilute—containing about 94 per cent. of water—that pigs would have to consume impossible quantities in order to assimilate an appreciable amount of solids; and, secondly, if whey is kept for any length of time in the dilute form it develops an increased acidity, which gives it a strong laxative action, rendering it of still less value as a pig-food.

On the other hand, if the whey is first concentrated by evaporating off a considerable amount of the water, both these troubles are overcome. The percentage of solids being much higher (say, 60 per cent. solids in the concentrated form), the pigs are able to assimilate more readily an appreciable amount; and, secondly, it is found that the concentrated product will keep indefinitely without developing any further acidity. Any concentration accompanied by better keeping-qualities will enable the whey to be stored readily, to be available for feeding over a longer period of the year, and transported at less cost.

A typical analysis is here given showing the composition of whey after the bulk of the fat has been separated for the manufacture of whey butter: Water, 94·70 per cent.; fat, 0·06; lactose, 3·51; protein, 0·78; ash, 0·51; lactic acid, 0·44; total solids, 5·30. It will be

seen that of the solids about 70 per cent. is lactose. The price paid for purified lactose makes its extraction from whey a profitable undertaking, but unfortunately there is only a very restricted demand for this article. The total annual consumption of milk-sugar for the whole of England is only about 400 tons, and this demand is already fully met.

When it is considered that the whey produced per year in New Zealand contains a total of about 20,000 tons of lactose, it is obvious at once that its extraction on a large scale is not feasible unless there is a complete revolution in the demand for this product. Precisely similar reasoning applies to the wholesale extraction of albumen, even if this were an economic possibility. One sugar-of-milk factory already in existence in New Zealand can supply all the requirements of this country, together with the demand from available markets outside. It would seem, therefore, that the only outlet for the utilization of whey on a large scale at the present time lies in the production of a concentrated product, from which a large percentage of the water has been removed, which would be suitable and find a market as a stock-food, more particularly for feeding pigs. Experiments are at present in progress along these lines.

The problem of the utilization of whey in England has been investigated by Dr. Harding, who did some preliminary work in 1922 for the Royal Agricultural Society of England. Later he carried out some large-scale experiments for the Ministry of Agriculture. The results of this work are published in Research Monograph No. 5 of the Ministry of Agriculture, "The Whey Problem and a Solution," by Leonard Harding, Ph.D. The paper describes the method adopted for condensing the whey at the cheese-factory, and deals fairly fully with the subsequent extraction and refining of the milk-sugar. The production of whey foods is dealt with briefly, and useful details are given of the costing of the various processes, and of steam requirements, &c.

In Harding's experiments an evaporator was set up at the Whitchurch branch of the United Dairies, Ltd., and the sugar-extraction was carried out at a factory at Haslington, some distance away. The whey condensed at Whitchurch was conveyed to Haslington in specially made 20-gallon churns. This arrangement was made to demonstrate the possibility of individual cheese-factories concentrating their whey before sending it to a central factory for sugar-extraction and stock-food production.

A specially-designed double-effect evaporator, utilizing a dry pump and barometric condenser, was employed at Whitchurch. The evaporator was capable of handling 2,000 gallons per day of eight hours, and it was worked so that the temperature in the first effect did not exceed 70° C., in order to avoid coagulation of albumen. The whey was condensed till it occupied less than one-tenth of its original volume, 100 gallons of the liquid being reduced to 8·75 gallons of the concentrate, which then weighed 110·8 lb. The concentrate is in the form of viscous liquid, and can be poured into cans for transport.

Tests on the evaporating plant showed a total steam-consumption (including steam for water-pump) of 5·85 lb. per pound of condensed whey produced. With an efficiency of 7 lb. of steam per pound of coal this means slightly less than 1 lb. of coal per pound of condensed whey.

Water was required for the condenser at the rate of 6,000 gallons per hour. At Whitchurch this water was drawn from one end of a comparatively stagnant brook and returned at the far end, the water being kept sweet by the addition of about ¼ lb. of chlorine daily. One man was able to look after the whole plant.

Taking the Whitchurch figures, and with coal at £1 5s. per ton, the cost of coal is about £1 2s. 6d. per ton of condensed whey. For labour, one man (at £3 per week) produced 12,000 lb. of condensed whey per week. This works out at £1 14s. per ton of the concentrated product (60 per cent. solids) for steam and labour on the evaporator. To this must be added interest on the plant (cost about £2,200) and depreciation, &c. Also, there is additional labour involved in the extra boiler-stoking required, and in some cases a larger boiler might have to be installed.

Harding's method of extracting the sugar is described in detail in the pamphlet. Whey foods were produced from the residue after removal of the greater part of the sugar, thus giving a higher protein/carbohydrate ratio to the food than is obtained with direct concentration without any sugar-extraction. In one case the liquor was dried when mixed with a suitable drying agent in the nature of a foodstuff—*e.g.*, bran, sharps, or grains, &c.; in the other it was simply concentrated by evaporation to a semisolid mass and sold in barrels. In either case it sold at about £12 per ton; but the latter was the more popular, although still containing about 34 per cent. of water. Both proved valuable as a pig-food.

In conclusion to the pamphlet, Harding says, "It is submitted that the work described in this report has demonstrated that—(1) Whey can be condensed to less than one-tenth of its bulk in an economic manner, without interfering with subsequent extraction processes; (2) condensed whey will keep indefinitely and can be easily transported in suitable packages; (3) given a sufficient quantity of raw material at a central factory, milk-sugar and animal-foods can be economically produced from condensed whey."

In New Zealand an investigation is being carried out by the Department of Scientific and Industrial Research to test the economic possibilities of using concentrated whey as a pig-food. Practical tests on the concentration of whey were made at the sugar-of-milk factory at Edendale, using the existing plant, which consists of an American double-effect evaporator made by Swenson. This evaporator is a very simple type, in which the heating steam passes through a series of pipes immersed in the whey. This kind is much easier to keep clean than the type used by Harding, in which the whey boils inside the tubes, which consequently require frequent cleaning.

Tests have been made working the evaporator at 15 in. vacuum in the first effect and 25 in. in the second. There is slight trouble due to frothing, but this can be overcome by the addition of a small quantity of cotton-seed oil (or other cheap vegetable oil). The temperature in the first effect (80° C. for 15 in. vacuum) is probably sufficient to coagulate the albumen, although no trouble from that source is apparent. The plant is probably capable of dealing with about 1,000 gallons of whey per hour, which would mean an output per eight-hour day of 3 tons (or more) of condensed whey produced from 6,000 gallons of

whey. Two thousand gallons of whey is condensed to a volume of 200 gallons, which weighs about a ton and contains approximately 60 per cent. of solids.

The tests indicate that not more than 1½ tons of coal is required for all purposes per ton of whey paste produced, and this figure could probably be reduced. For labour on an evaporator of this size (3 tons output per day) one full-time man together with an extra boiler hand would be required, with possibly occasional assistance. As to capital cost, £3,000 is an estimate of the total installed cost of an evaporator of the type at Edendale. On the assumption that the existing cheese-factory boiler can supply the steam required, which is probably not justified (see below), a rough estimate of the cost of production of 3 tons of whey paste would be as follows: 4½ tons coal at £1 10s., say, £6 15s.; labour—two men, per day, £2; interest and depreciation per day (200 days per year), £1 15s.: total, £10 10s.

This is about £3 10s. per ton according to cost of coal, and no allowance has been made for any payment for the whey (2,000 gallons needed per ton of paste would cost £2 at ¼d. per gallon), or for barrels or other receptacles, &c. Also, the following figures indicate that additional boiler-capacity would be required at many factories. Take as a typical example a cheese-factory with an annual output of 400 tons making during the flush season 2 tons of cheese per day and utilizing a 20 h.p. boiler: Two tons of cheese per day would mean a production of about 4,500 lb. of whey per hour for eight hours each day. For concentration in a double-effect evaporator this would require approximately 3,000 lb. of steam per hour (over the eight hours), which represents the full output from a boiler of about 86 h.p. capacity. For the examples quoted, therefore, the existing 20 h.p. boiler would be quite inadequate. For smaller factories and periods other than the flush season there would be much less divergence between the steam required and that available from the existing boiler.

Analyses have been made of the whey paste produced at Edendale, and the following is typical: Water, 49 per cent.; protein, 6; ash (mineral), 4·7; acidity (as lactic acid), 1·2; fat, 0·3; sugar (by difference), 38·8.

Several tons of the paste have been prepared and distributed for trials of the feeding-properties for pig-raising at Lincoln, Weraroa, Palmerston North, and Ruakura. Its food value is also being tested by Dr. Malcolm at Otago University.

[NOTE.—Reports on certain of these trials will be published in a subsequent issue of the *Journal of Agriculture*.—Ed.]

Improvement of Second-growth Country.—The annual report of the Fields Division for 1927–28 states: "The Lands Department is now conducting a demonstration farm in Whangamomona County under the provisions of the Deteriorated Lands Act. This farm is being run on economical lines, but, with the work that is being put in to it on good-management methods, considerable improvement both as regards carrying-capacity and appearance is already being shown. The instructional officers of the Fields Division continue to co-operate with the officers of the Lands Department in the work necessitated in connection with advances under the Deteriorated Lands Act, particularly in the King-country."

THE CLIMATE OF NEW ZEALAND.

E. KIDSON, M.A., D.Sc., Director of Meteorological Services, in the "New Zealand Official Year-book, 1929."

THE problem of the classification of the climate of a country may be regarded from various aspects. First of all, there is its solar climate, which depends on the amount of heat it receives from the sun and the variations of this amount with the seasons, and which is determined solely by the latitude of the country. New Zealand lies wholly within the Temperate Zone, and on the equatorial, or warmer, side of it. The amount of heat received from the sun is therefore never excessive even in the far north, while even in the middle of winter and in the southernmost portions, on the other hand, the sun rises high enough to give considerable warmth during the day. The difference in length between the longest and the shortest days in the year is about four and two-thirds hours in the northernmost and seven and one-third hours in the southernmost extremity of the Dominion. The day has never so short a length as eight hours.

If the surface of the globe were homogenous—if, for instance, it were all ocean—all places on the same parallel would have the same climate, and there would be no need for any other classification than according to solar climate. Instead of this, however, we have a varying surface, some of it being land and some water, while the land surface varies in nature and in elevation. Solar radiation has very varying effects on these different types of surface, and these in turn react in different ways on the atmosphere. Based on these physical conditions, then, we have two main types of climate—viz., continental and marine. A marine climate is controlled to a large extent by the waters of the surrounding ocean areas, and, since New Zealand nowhere has any great breadth, its climate is of the marine type. The distinctive feature of such a climate is its sluggishness as regards temperature changes when compared with a continental one. When sunshine falls on a land surface most of it is absorbed in a very shallow layer and converted into heat. The surface, therefore, tends to become very hot. Water, on the other hand, reflects a large portion of the sun's heat back through the atmosphere, whence it is lost. Such radiation as is absorbed penetrates to a considerable depth, so that the rise of temperature at the surface is slight. Even then a good deal of the heat thus accumulated is expended in evaporating water. Over the ocean, therefore, there is very little difference in temperature between the coldest part of the day, just before sunrise, and the hottest, in the early afternoon. Over the land the difference is considerable, and increases, generally speaking, with the distance from the shore. Similarly, in a marine climate the difference between summer and winter is relatively small. Another effect of the sluggishness in temperature changes is that the seasons lag behind the movement of the sun. The spring is cold, although the days are getting longer and the sun higher and stronger. It is common knowledge in New Zealand that we are liable to cold snaps practically up to Christmas. Frosts damaging to vegetation are not rare in November, and snowstorms occasionally affect comparatively low-lying

country even later in the year. On the other hand, the autumn is warm. In New Zealand mild temperatures may be experienced well into April. A marine climate is generally characterized by high average rainfall, its atmosphere being abundantly charged with moisture evaporated from the sea.

Generally speaking, then, the climate of New Zealand is equable, with an abundant precipitation, which is spread fairly uniformly over the different months. Not only is this so, but the difference in climate between the northern and southern extremities is comparatively slight in view of the fact that the Dominion covers a range of nearly 13 degrees, or about 900 miles, in latitude. The mean temperature at sea-level falls from about 62° F. in the far north to about 50° F. in the far south.

Another aspect from which there is an increasing tendency for geographers and meteorologists to classify climates is that of the vegetation produced by the soil. There are many plants which are able to live only within certain definite climatic limits, and others require certain restricted conditions to produce satisfactory growth. Since man depends so much for his livelihood on the products of the soil, the classification of climates on this basis is a logical and very useful one. From this point of view New Zealand has a warm-temperate and humid climate. The rainfall is almost everywhere sufficient for plant requirements all the year round. The temperature of 50° F. is an important one from the biological point of view, since many plants of the temperate region do not grow well unless the air rises above this temperature for considerable periods. Nowhere in New Zealand are there more than five months with a temperature lower than 50° F. In the Auckland Peninsula and coastal places a little farther south, mean temperatures do not fall below 50° F. in any month. As regards the settled portions of the Dominion, it is only in the elevated regions of Otago and Southland that the mean temperature falls slightly below 40° F. in some of the coldest months, or that the mean minimum for any month falls below freezing-point; consequently the ground is nowhere continuously frozen for long periods. Owing to these mild temperatures, there is some growth of herbage practically the whole year round. Vegetation has no long period of rest, and deciduous trees are practically unknown.

Since temperatures are everywhere warm enough to promote growth and nowhere excessively hot (the mean maximum for any month probably nowhere reaches as high as 80° F. or the mean temperature as high as 70° F.), there is comparatively little difference between the North and South as regards the nature of the things grown. Grapes, for instance, can be grown successfully out-of-doors in parts of all provinces of the Dominion. Certainly, in the North such semitropical products as citrus fruits can be grown successfully, whereas in the South this is not possible.

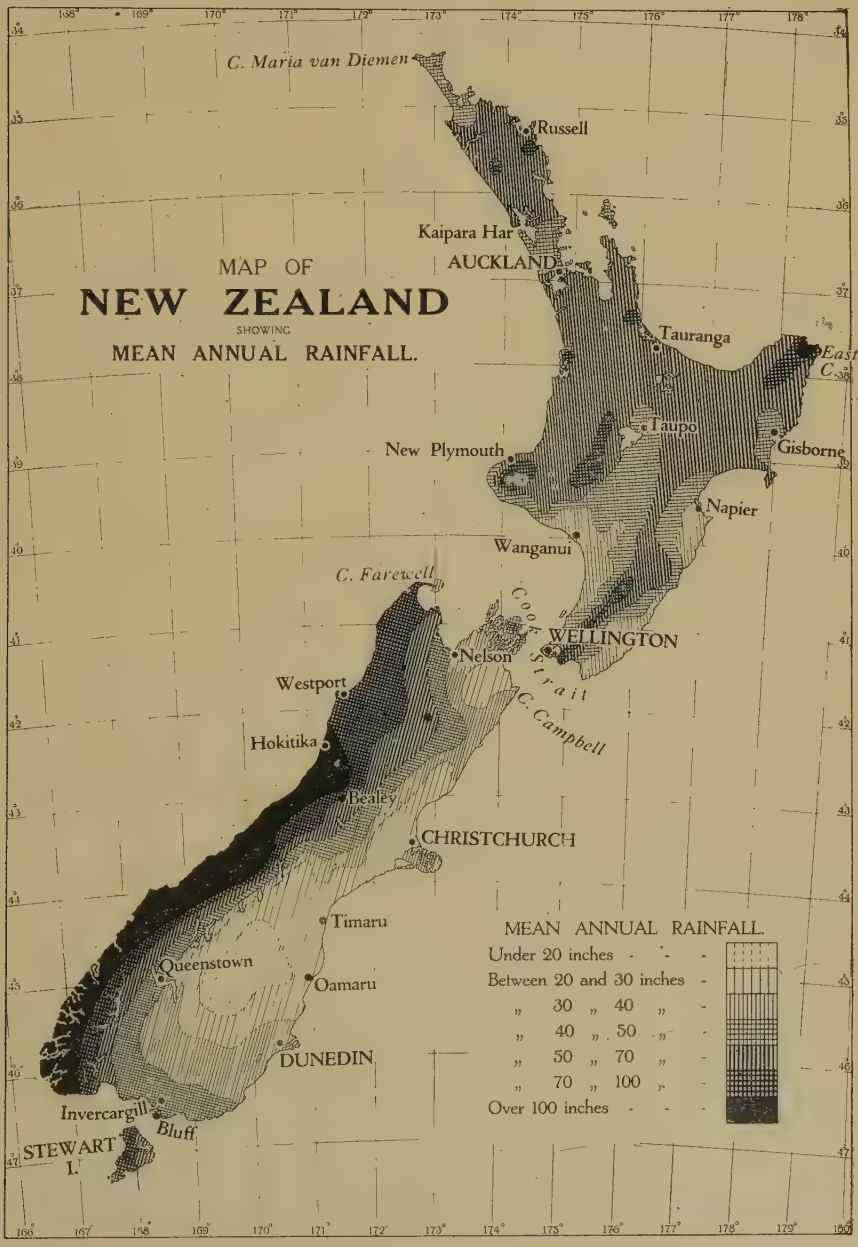
As regards human occupation, New Zealand lies in the zone of the Southern Hemisphere which is subject at all times of year to frequent moving barometric depressions, with all their accompanying weather-changes. Some experts consider this an important condition for the development of civilization in its highest form. Cloudiness is nowhere excessive, so that there is plenty of sunshine, and a considerable range

between day and night temperatures, which again tends to produce bracing conditions. Indeed, there can be few countries so admirably adapted for the production of a high yield from the soil and the maintenance of a high standard of comfort and civilization as New Zealand.

The Dominion is in the region of prevailing westerly winds. North of about New Plymouth and Napier these westerlies are not, in the main, strong, and, in fact, in summer there is a prevalence of south-easterlies. Though these can scarcely be classed as trade-winds, even in the far North, they are to a large extent part of the same system. South from the 39th parallel of latitude the westerlies prevail, and although in the free air, at least, their mean strength increases the farther south we go, they are of considerable average force even in Taranaki and Hawke's Bay.

We next have to consider the feature that exercises the most potent influence in modifying climate in New Zealand—that is, its mountain-ranges. Such variations of climate as are encountered in the different parts of the Dominion are produced mainly by these ranges. Their effect is closely associated with the prevalence of westerly winds. A range of mountains presents an obstacle to a wind which meets it. To force the air up and over it requires a great deal of energy. Wherever possible the wind will flow round rather than over. The most notable instances of this effect in New Zealand are found in the Cook and Foveaux Straits regions. Air in a westerly wind is forced round and over the lower portions of the northern part of the South Island into Cook Strait. Some of the air thus entering the strait possibly comes from as far south as Westport when the general wind is from due west. At the same time, the ranges in the North Island deflect into a southerly direction all winds which strike south of Cape Egmont. Some of the air is forced through the comparatively low gap in the neighbourhood of the Manawatu Gorge, while the greater part goes on down to Cook Strait. Similarly, in the south-west corner of the Dominion, a westerly wind is deflected into a north-westerly and flows round Puysegur Point into Foveaux Strait. A south-westerly wind is deflected into a westerly through the strait. The two regions mentioned are ones through which winds from a considerable area are forced to converge, and the consequence is that they are subject to an unusual proportion of strong winds. Through such channels it is practically only possi le for winds to have one or two directions—*i.e.*, they must blow through the straits from one direction or the other. Owing to the great preponderance of winds from a westerly quarter, the prevailing direction in Cook Strait is from the north-west. This wind may correspond with any direction between north-west and south-west in the open ocean waters where winds are unimpeded. More rarely there are strong winds from an easterly direction, which produce south-easterlies in the strait. These may correspond with any wind between north-east and south over the open waters to the east. In the South the predominance of westerlies is greater than at Wellington, but there are at times strong easterlies through Foveaux Strait. Though not on the same scale, effects of a similar kind are noticeable in other parts. Round East Cape, for instance, there is a tendency for winds to be deflected along the coast-line, and easterly winds are likely to be specially strong there. At Nelson there is a different effect, and westerly winds tend to be deflected

down Tasman Bay as south-westerlies, but at the head of the bay meet the winds which have come round Cape Farewell and are checked. If the general wind, therefore, is between north-west and west-south-west about, the winds are usually light at Nelson.



When the general wind is almost due south-west, or practically parallel to the main range in both Islands, many parts of the Dominion are protected. Strong south-westerly winds may be blowing and wet weather prevail in the southern parts of Otago and Southland, and also in Taranaki and the northern parts of the Auckland Provincial District, while much of the rest of the country, including the inland portions of Otago, Canterbury, and Marlborough, the east coast of the North Island, and especially Cook Strait, experience unusually fine yet bracing weather and comparatively little wind. A slight deviation of this wind to one side or the other means bringing unsettled weather to the west coast of the South Island or to the eastern districts from East Cape southwards.

The checking of the westerly winds by the Southern Alps results in a large proportion of variable winds on the west coast of the South Island.

Although it is true that wind will flow round an obstacle in preference to climbing over it, yet when a broad belt of winds meets a mountain barrier lying across its path much of the air must be forced over the range. This happens when the prevailing winds, which are from between north-west and west, strike the Southern Alps, and, to a less extent, the ranges of the North Island. The distribution of rainfall over New Zealand is greatly influenced by this fact, as can be seen from the accompanying rainfall map. Most of our rain is produced from moisture carried from warmer latitudes by north-westerly winds. The rain falls either in the north-westerlies or when the latter are forced up by colder south-westerly winds. When the westerly or north-westerly winds are driven over the mountain-ranges they rise into regions in which the air-pressure is much reduced. They are, in consequence, cooled. The colder the air is, the less uncondensed water-vapour can it contain. Moisture is therefore condensed, and falls as rain on the mountain-tops and their western slopes. Generally speaking, therefore, districts with a westerly aspect have the heaviest rainfall. This is especially noticeable in the South Island, where the west coast opposite the Southern Alps has an excessive rainfall, while in their lee we have the driest areas in New Zealand, that in Central Otago being the most notable. Round Mount Egmont is another area of heavy precipitation. The East Cape district has a high rainfall because it gets a good deal of the north-westerly rain, and is also subject to very heavy falls in easterly winds which occur in connection with cyclones in the neighbourhood of the North Island.

When the westerly winds blow over the mountains they sometimes shoot down them again on the opposite side. Falling into levels where the pressure is higher, they are heated, just as the air compressed in a bicycle-pump is heated and warms the pump. Having lost a good deal of their moisture, they are very dry, and the energy gained by falling down the mountain-slopes adds to their speed. We therefore have the gusty, hot, dry wind which is characteristic of mountain regions and is called the "Föhn" wind. The Canterbury Plains, especially the portions near the foothills of the Alps, are one of the regions of the world where the Föhn effect is most notably developed. The characteristics of the north-west wind are well known to the dwellers in those parts. During the Föhn wind a band of clear sky is produced on the leeward

side of the mountains, while farther away cloud often forms again at a considerable height. This gives the characteristic appearance of the "Föhn arch." Though most strongly developed in Canterbury, Föhn winds are experienced also in Otago, parts of Marlborough, and from the Wairarapa to Hawke's Bay.

Föhn winds, owing to their high temperature and to the fact that relatively high pressure tends to be produced in them on the west side of the ranges and relatively low on the east side, are often underrun by east or north-east winds on the east coast. These are especially prevalent in Canterbury, and the north-easter is a persistent and humid wind of an unpleasant type.

The shelter given from the ocean-winds, and the clear dry atmosphere produced by the mountains, causes a nearer approach to continental conditions in their lee than in other parts of the country. The greatest extremes of temperatures are found in these regions.

In addition to the climatic effects above described, there are others produced by mountains and due directly to the elevation. Other things being equal, the amount of precipitation increases with elevation, until about 5,000 ft. or 6,000 ft. is reached. Higher than that, it falls off again owing to the fact that the cold air above those levels is able to hold little moisture. Again, the greater the height above mean sea-level, the lower the mean temperature, the difference being about 3·5° F. per 1,000 ft. There are no closely settled areas in New Zealand sufficiently high for the elevation to produce any very marked influence on the climate. The effect is to some extent counterbalanced, too, in most places by the facts (1) that the sloping ground prevents the accumulation of cold air on the surface, so that night temperatures are less extreme than they might otherwise have been, and (2) that the atmosphere is more transparent, owing to the reduced amount of vapour it contains and the absence of dust, so that the sun seems to give more heat.

Above about 5,000 ft. snow frequently lies for long periods and the climate is severe. Forest-trees become more and more stunted as this height is approached, and finally are unable to survive. Beyond it we have a mountain climate and characteristically alpine flora. The latter is adapted for resistance to drought, although actually the rainfall is usually heavy. The adaptation is necessary because of the rapid drainage, the intense heat produced on still clear days by the sun's rays, and the cutting-off of water-supplies from the roots for long periods owing to the freezing of the ground. Even in these high regions, however, conditions are not extreme. It is probably very rarely indeed that the temperature falls as low as 0° F., except perhaps for short intervals and in sheltered basins. The mountain region of the Southern Alps is, nevertheless, of great interest on account of its large and characteristic glaciers. The Franz Josef Glacier is especially famous, owing to the fact that it descends almost to sea-level, although the latitude is comparatively low. No doubt the very heavy rainfall on the mountains in this district and the rapid fall to sea-level are chiefly responsible for this effect.

Tables giving average values of various meteorological quantities for a number of typical stations, and serving to indicate the variation of climate in the different parts of New Zealand, are appended to the article in the Year-book. For comparisons with New Zealand conditions, data are also given for Kew Observatory,

near London, and for Aberdeen. It is shown that even at Kew the mean temperature is lower than at Queenstown or Invercargill, while at Aberdeen the mean maximum is less than 2° F. higher than the mean temperature at these stations. Again, the number of days with rain is much higher at the British stations than in New Zealand for rainfall totals of corresponding amount. The Dominion also has a much larger average amount of bright sunshine.

A SIMPLE PUMPING METHOD FOR MILKING-SHED DRAINAGE.

J. W. SMITH, Dairy Instructor, Palmerston North.

AN efficient and profitable method for handling manure and drainage from a milking-shed where there is no natural fall consists in the use of a small sump, a manure-pump, and a square 400-gallon tank or other suitable receptacle placed on wheels. The cost of the outfit is small when one considers that the manure spread on the land is a valuable top-dressing, and that the farmer is at the same time getting rid of what is a source of nuisance at the dairy.

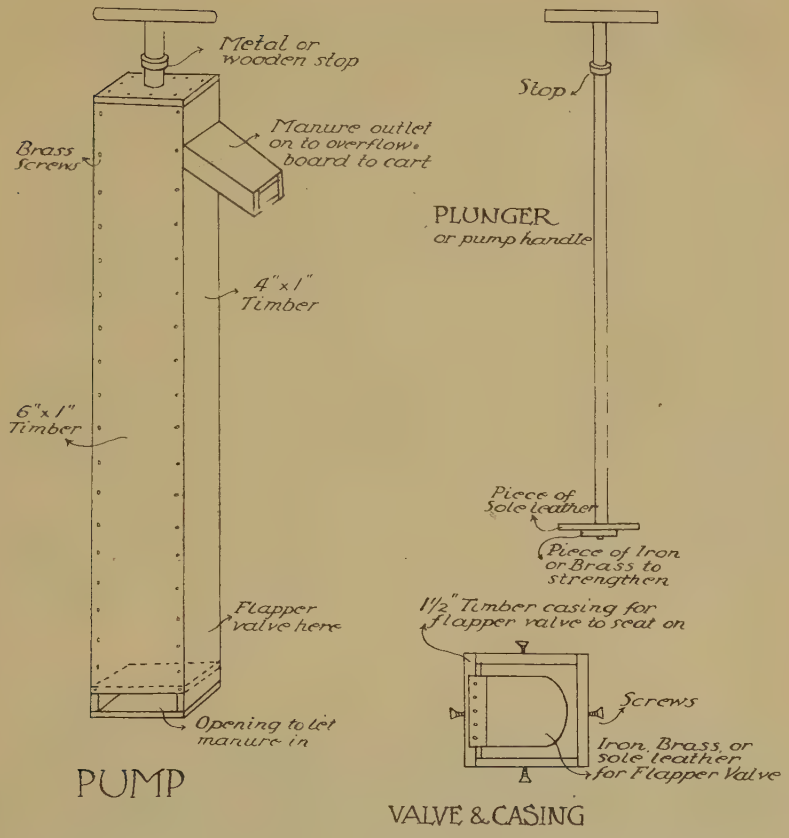
The requirements for this pump are two perfectly straight boards 6 in. by 1 in., and two boards 4 in. by 1 in., both of heart rimu timber; one straight pole (an oar for a row-boat cut down to a suitable length is recommended); 1s. 6d. worth of good heavy sole leather; two small oblong pieces of iron or brass; and a number of brass screws. The length of the boards and pole or plunger depends upon the height of the tank on the vehicle. The timber must be screwed together in the form of an oblong box by brass screws, and made airtight. An opening or overflow should be made about 4 in. from the top of the box, and an opening 1 in. from the bottom to let the manure into the pump.

A flapper-valve should be made separately and fitted into the bottom of the box about 1 in. up from the bottom, using 1 in. or 1½ in. timber as the casing for the flapper-valve to sit upon: This frame is attached to the box by means of four screws, so as to permit convenient handling should it be necessary at any time to adjust or renew the flapper-valve. Use one piece of iron with part of the sole leather for the flapper-valve, to ensure having sufficient weight for a perfect seating.

A piece of sole leather should be placed at one end of the straight pole, the underneath side being strengthened by the other piece of iron, or brass, while at the other end a piece of wood is firmly screwed crosswise to act as a handle. The plunger-rod is then complete.

Any blacksmith or carpenter can make a pump of this kind for about £2 or £3—possibly less. The advantage of having only the one flappper-valve in the pump is that it permits the inflow of thick drainage matter, and the plunger helps to break up any hard lumps or mud; moreover, by taking out four screws the valve can easily be renewed at any time.

The tank or container should be fitted with a 3 in. tap, and the drainage matter can be permitted to flow into a box at the tail of the cart, in which there are evenly spaced openings, while a chain harrow can be hooked on to the axle of the cart for raking the manure into the ground.



SKETCH OF THE MANURE OR DRAINAGE PUMP AND ITS PARTS.

If the farmer objects to the manual labour of pumping, he can fix up a counter-shaft and work this pump from the engine. The disposal of drainage from the milking-sheds at some of the farms in the writer's district is being successfully operated by this method. The accompanying sketch will give a good idea of the details of construction.

Soil Fertility and Plant Nutrition.—Reporting on the recent International Soil Congress, held at Washington, Mr. T. Rigg, New Zealand delegate, states: "One of the more important subjects discussed by the commission dealing with plant-nutrition problems was that connected with the intake by plants of food in the soil. Investigations of various workers conducted on acid soils have shown that the amounts of phosphate found in the soil-water bear little relationship to the amounts taken up by plants, or indeed added to the soil in manurial treatment. It now seems probable that the plant itself possesses special functions in the acquisition of the plant-foods contained in the soil. Some workers have suggested that the intimate relationship of soil-particles and root-hair must be viewed as a single system. In this system the root-hairs possess special facilities for attacking insoluble mineral plant-food. Other workers have suggested that the rate of evolution of carbon dioxide from the roots has an important bearing on the solution of mineral plant-food."

CASEOUS LYMPH-ADENITIS IN SHEEP.

PRECAUTIONS FOR SHEEP-FARMERS.

Live-stock Division.

THE condition known as caseous lymph-adenitis, found in sheep, is characterized by the enlargement of the lymphatic glands (commonly known as "kernels") of the body and the production in them of collections of a greenish-coloured pus, which, when the condition has been in existence for some time, becomes converted into a cheesy-looking material.

Lymph-adenitis is present in New Zealand to a limited extent, but it shows indications of spreading, hence it is specially necessary for sheep-farmers to take all known precautions to prevent it. In Australia, Argentina, and Uruguay it is evidently very widely distributed, and recently the British authorities imposed some restrictions upon imported mutton from these countries on account of this trouble. The presence of lymph-adenitis in the glands does not necessarily render the carcass unfit for human consumption, but it does depreciate its value from a trading viewpoint; hence the necessity for doing all that is practicably possible towards controlling and eradicating this trouble.

Lymph-adenitis may be found in lambs and hoggets, though aged ewes are most commonly affected. In lambs becoming infected a condition of pleurisy is sometimes set up. It occurs in all breeds of sheep, and it is a matter of economic importance that sheep-farmers should take precautions to prevent, as far as possible, the spread of infection.

There is very little evidence to show that the disease may be caused through ingestion of food or water contaminated with the organism which is the cause of the disease. As the trouble is more frequently located in the "kernels" situated at the upper regions of the limbs, this fact would suggest that the most common mode of entry of the organism is through accidental inoculation of wounds. That view is supported by work carried out at the Wallaceville Veterinary Laboratory, where more or less typical lesions have been set up by the experimental inoculation of skin wounds. Hence it is necessary that careful precautions be taken to prevent infection of wounds accidentally made during shearing and crutching.

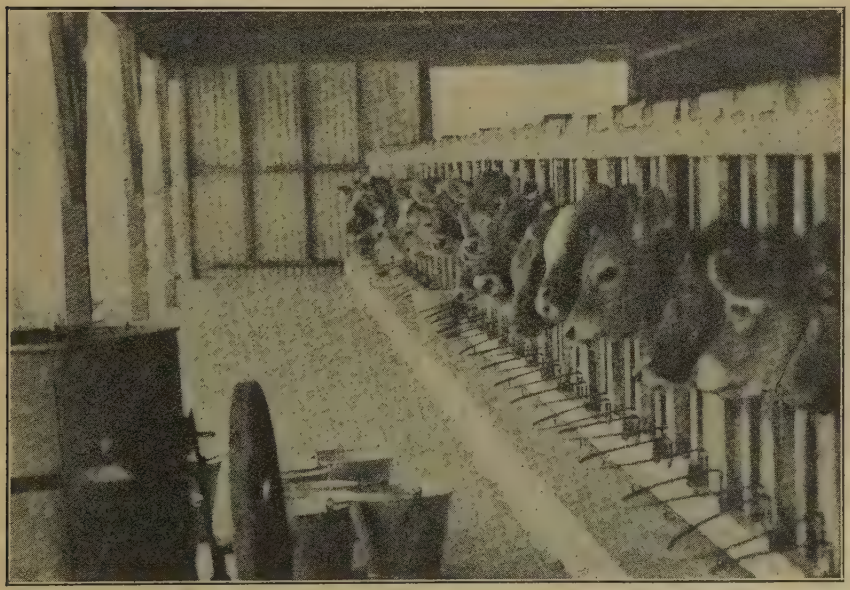
It is customary where hand shearing is practised to frequently dip the blades in a reliable antiseptic, and this should always be done. It is most important that all wounds should be at once dressed with some antiseptic preparation. If this precaution were carefully and efficiently observed in every case it would be of the greatest value in assisting towards preventing the setting-up of lymph-adenitis in the sheep which have sustained the wounds, and also in helping to prevent the spread of the disease generally.

It has not been absolutely proved that infection is present in the surface soil of yards and of their immediate surroundings, but

sufficient circumstantial evidence exists to warrant giving the advice that, wherever the trouble is known to be present among the sheep on any property, it will be a wise and desirable precautionary measure to either saturate the soil of the yards with a strong antiseptic solution —say, one part of non-poisonous dip to twenty parts of water—or, what is better still and more thorough, to remove the whole of the surface soil for a depth of at least 9 in. and replace it by fresh clean soil, such as could be obtained by excavating into a hillside.

In addition to the yards, there is a possibility that holding-paddocks nearby, which may frequently be used for temporarily accommodating large mobs of sheep, may be more or less contaminated. Where it can be conveniently done, it will be a good plan to plough up, cultivate, and resow such paddocks at intervals of a few years.

The dressing of all wounds seen at shearing-time is a very necessary precaution. This fact is brought to the notice of the Department from time to time when losses occur from blood-poisoning after shearing. Any extra labour involved is therefore worth the trouble by reducing the prevalence of lymph-adenitis and also as a preventive of blood-poisoning. That ewes are more commonly affected may be due to the fact that, owing to their longer life, they are more often exposed to infection of wounds liable to be caused during shearing and crutching.



CALF-FEEDING BAILS AT RUAKURA STATE FARM.

SEASONAL NOTES.

THE FARM.

CATCH-CROPS FOR GREEN FEED.

In the more humid arable farming districts of Canterbury catch-crops of cereals are frequently sown on stubble land to provide autumn green feed. In these districts short rotation rye-grass pastures are commonly rotated with roots, rape, and cereals, and during the dry summer and autumn weather little or no feed is provided by these rye-grass pastures. The green cereal crops provide the necessary rich succulent feed to flush the breeding-ewes prior to their running with the rams, and to carry the ewes in good condition until the later autumn rains bring on the green pastures. Although the yield per acre from green cereals is not high the feed thrown is very nutritious, and the crop grows well under dry-soil conditions. The earlier the green feed is got in the better, so that the first sowing usually follows early-harvested autumn-sown oats. Algerian oats or Cape barley are the cereals usually sown for green feed, the latter being generally the most successful when the soil conditions are very dry. On light and medium land the green crop can be most cheaply established by broadcasting the seed on the stubble and covering with a one-way disk cultivator, or by skim-ploughing.

The seed-bed for green cereals is also frequently prepared by ploughing and working down in the ordinary way prior to drilling the crop. Although this method entails more time than the previously mentioned one, the work put into the land for the green cereal lightens the cultivation work necessary in the following spring prior to sowing the land in root or forage crops.

LUCERNE.

Young stands of lucerne sown about the end of November and in December should be ready for their first cut in February. Many promising stands are ruined by too early cutting in the first year. The first cut should not take place till the young plants are blooming and fresh buds have appeared at the base of the plant. Cutting before this stage is reached greatly weakens the vigour of the young plants. Most late spring-sown stands of lucerne will produce a strong second growth during the first season, but unless the crop is mature—*i.e.*, the crop is in bloom and fresh buds have appeared—before the late autumn the stand should not be cut, but the herbage left on the plants over the winter. The leaving of the herbage encourages a more vigorous root and leaf development the following season.

With old-established stands it is also advisable to leave a good cover of herbage on the plants over the winter. Many promising stands are injured by grazing the crop hard in the winter. Rye-grass, Poa annua, white clover, catsear, and rib-grass—all common weeds of lucerne—establish themselves where there is a short turf and plenty of light. Cutting in the late autumn and grazing during the winter when the lucerne is practically dormant thus expose the stand to weed invasion.

SOWING OF SECONDARY BURNS.

Should favourable weather conditions prevail during the next few weeks, settlers on surface-sown hill country will have the opportunity of cleaning up areas that have reverted to fern and second growth. On areas where the fern growth is not too thick and beneath which is a turf containing danthonia, paspalum, brown-top, or Lotus major, the pastures can be brought back with burning and regulated stocking. Land that has completely reverted must be burned and resown, and it is desirable to burn in the autumn rather than in the summer, and to sow the grass-seed as soon after the burn as possible. A good general mixture would be as follows: Perennial rye-grass, 6 lb.; crested dogstail, 4 lb.; brown-top, 2 lb.; white clover, 1 lb.; Lotus major, ½ lb.; Danthonia pilosa, 3 lb.: total, 16½ lb. per acre.

Perennial rye-grass establishes rapidly and throws a fair quantity of feed as long as a certain amount of ash remains round the plants. Crested dogstail establishes very well on secondary burns, and is very valuable in that it maintains a cover on the ground between the going-out of the rye-grass and the coming-in of the slower-establishing grasses, such as Danthonia, brown-top, and paspalum. Brown-top gives a cheap cover and a permanent sward, and 2 lb. of brown-top seed should be included in all mixtures for secondary burns. White clover provides a cheap and quick cover, and, where top-dressing can be practised, is likely to be permanent. New-Zealand-grown white-clover seed should always be sown in preference to imported white clover. Lotus major is rather slow to establish, but spreads rapidly after its third year. It is particularly valuable for sowing on weathered slips and patches of loose soil. Danthonia pilosa, although slow to establish, will ultimately give a permanent sward under hard surface-soil conditions, and should be included in all mixtures. Paspalum should be included in all mixtures on country where it is likely to succeed; unfortunately, the establishment of this grass is both slow and erratic. On the more accessible, better-class country the burn should be top-dressed immediately after seeding; on poor high country top-dressing is often impossible, and the aim should be to get such land into danthonia.

SUMMER SUPPLEMENTARY FEEDING OF DAIRY COWS.

The prolonged spell of dry weather experienced last summer has led this year to a great increase in the conservation of some of the surplus early summer production of grass, as ensilage for feeding dairy cows during the dry autumn weather. The making of grass ensilage should become just as much a matter of routine on dairy farms as the making of hay. Grass ensilage can be most easily conserved in pits or trenches, and it is really much easier to convert grass into ensilage when pits are used than to make it into hay. The great advantage of grass ensilage for summer supplementary feeding is that it can be saved in years of good rainfall and abundant grass-growth, and kept for dry years. A stack or pit of grass ensilage is the safest insurance policy a dairy-farmer can hold against drought.

Paspalum could well be more widely cultivated in the southern part of the Auckland Province as a summer feed than it is at present. The common idea that once paspalum is sown it will eventually spread all

over the farm, smother out all other grasses, and leave the farmer with no winter or early spring feed is quite wrong. Experience has shown that where regular top-dressing is carried out and proper pasture-management methods adopted, mixed pastures of rye-grass, cocksfoot, and paspalum can be maintained. Paspalum will not spread into an ordinary rye-grass, cocksfoot, and clover pasture as long as the pasture has a close sward. Paspalum usually establishes itself in a mixed pasture where the turf is opening up, and really occupies spaces that would otherwise be growing weeds. The best way to establish paspalum is to sow 5 lb. or 6 lb. of seed with the ordinary permanent pasture mixture used in the district; or the paspalum-seed may be sown with Japanese millet in the summer, and rye-grass and clovers later established by disking the millet stubble and broadcasting the grass mixture and manure.

—P. W. Smallfield, B.Ag., Fields Superintendent, Auckland.

THE ORCHARD.

FRUIT-EXPORT POINTS.

THE chief consideration of the commercial orchardist during the next two or three months will be the harvesting of the apple and pear crop, and the preparation for export of a good proportion. The work entailed is exacting, and numerous details must be closely watched. In order that efficient work may be done and labour costs reduced to a minimum, some time should be spent in making ready for the season beforehand. Firstly, it would be well for the exporter to study closely the grading regulations, and generally acquaint himself with all the requirements. Comfort and convenience in the packing-shed increase efficiency and decrease costs. Some rearrangement of the shed may therefore be advisable, with the idea of reducing confusion and extra handling of cases. Fruit coming in at one point, having been passed over the grader and packed, should be worked towards a loading-out point. Even the smallest shed may be so arranged as to minimize handling.

The actual work of grading is made light or heavy according to the quality of the fruit and the way in which it has been picked. This is a matter which the orchardist may largely regulate himself. Firstly, in the producing of the crop, for the success of his season's operations thus far is largely reflected in the quality of fruit coming on to the grading-table. Good fruit is easily and inexpensively graded, and may be expected from an orchard where the trees are in good heart, diseases have been controlled, and the crop has been sufficiently thinned and blemished fruits removed in the process. Secondly, all possible assistance should be rendered to the packing-shed staff, the graders in particular, by selecting during picking operations only those fruits which are up to the standard for export. Pickers should be made acquainted with grading regulations, and thus avoid picking fruit not up to standard. All obvious rejects should be discarded during picking, in order to lessen the number of rejects finding their way into the packing-shed.

The need for care in picking and handling cannot be too often emphasized. Fruit must be picked with stalk intact. Picking-bags should not be overfilled, nor should picking-boxes be made too full. Fruit should be taken in the palm of the hand and lifted, not pulled. The latter method often damages fruit-spurs and wrenches the stalk from the fruit. Picking of fruit at the right stage of maturity is most important. Immaturity is a particular evil which should be avoided. Several picks should be made, the first usually being moderately light, when the fruit should have taken on a perceptible change in ground-colour.

In the actual packing care must be exercised to develop a good pack. Excessive bulge is deprecated, but a medium bulge with no looseness at the sides of the cases will ensure good carriage.

SPRAYING.

Although the main spraying operations may have been completed by this time, some consideration must still be given to the matter of control of diseases and pests. Damage by codlin-moth and leaf-roller caterpillars must be prevented, and attention still be given to the later varieties. Late infections of black-spot sometimes occur, and leaf-hopper may have become troublesome. Care must be used in the employment of future sprays, avoiding as far as possible spray-stains. Heavy combination sprays, especially such mixtures as lime-sulphur, arsenate of lead, and Black Leaf 40, may be avoided. For the latest spray prior to picking, arsenate of lead only with a spreader will reduce stains to a minimum. The use of an excessive amount of lime leaves an objectionable white residue. Apple leaf-hopper, if allowed to become prevalent at this period, causes the fruit to become unsightly. Black Leaf 40, at 1–800, if applied at short intervals, will reduce this pest. Certain varieties, such as Dougherty, often develop black-spot quite late, and applications of lime-sulphur, 1–125, may be advisable up to the end of the coming month in a season when black-spot has been prevalent.

MISCELLANEOUS WORK.

Sanitary methods in and around the packing-shed should be exercised. Fruit affected with brown-rot and grubby apples and pears should be destroyed, as these are a prolific source of infection for the following season.

Cover-crops may still be sown if the land is in good order. A dressing of super., 3 cwt. to the acre, will benefit the cover-crop and give a far greater bulk of growth for ploughing under.

Grafts will still be making strong growth, and may require tying to prevent injury in strong winds.

Implements and the spray outfit, when finished with for the season, will have a longer life if given a little consideration. Place them under cover, and well grease all bearing surfaces.

Heavily laden trees may require some tying or propping. Every effort should be made by these means to prevent the splitting of trees or the fracture of large limbs.

Hail damage where very severe, having caused damage to foliage and bark, should not be accepted without making some effort to relieve the trees when in a weakened state consequent upon such injury, otherwise the effect will be felt in a marked degree in the following season. To more or less abandon the orchard till the next season is fatal. Removal of damaged fruit, and continuing with cultivation and disease control, will help to repair the loss and make possible the carrying of a crop the following season.

—N. J. Adamson, Orchard Instructor, Hastings.

Citrus-culture.

The most essential work at this period is conservation of moisture. Irrigation is not generally practised in the citrus-groves of New Zealand, but where water is available it could be done with great advantage to the trees during the dry period normally experienced in January and February. Several special points should be remembered when such watering is done. Applications should be adequate and periodic rather than a little and often. Endeavour should be made to get the lower soils saturated and the surface soil reworked to open condition in order to reduce evaporation. The best method of applying water is to ridge up the intervening land as though moulding potatoes, flood the trenches to at least equal 1½ in. rainfall, and the following day, when the damp soil has lost the sticky texture, cultivate the land to level back the ridges, thus leaving a mulch of dry crumbled earth on the surface. Surface watering gives rise to great evaporation, and besides consequent loss of water it has a tendency to encourage the roots to the surface. Where water is not available continue the surface cultivation of the soil, and if possible mulch with rough litter over the rooting-area.

Harvest all fruits as soon as ready; do not allow ripening fruits to develop on the tree and unduly tax it at this period of strain. Where for any reason trees have to be severely cut back this is the best season of the year to do so.

—W. H. Rice, Orchard Instructor, Auckland.

POULTRY-KEEPING.

GREEN FEED FOR HOT WEATHER.

JANUARY is usually one of the hottest and most trying months of the year for fowls of all ages. It is therefore important that they be given the best possible care and attention to ensure best results. It is a time when the birds require an endless supply of succulent green material for the maintenance of good health and vigour. Especially does this apply to the growing stock. It is common at this time for the birds to tire of their grain ration, and if not provided with an abundance of green food they will fail to thrive.

PROTRUSION OF THE OVIDUCT.

In the case of hens intended for table purposes—say, in March—it will be found a wise course to provide a forcing diet so that every possible egg may be secured before they are disposed of. A good supply

of boiled meat, meat-meal, or skim-milk added to the ration will tend to promote heavy egg-production. Of course, when providing a highly forcing ration there is always the risk that ovarian disorder will follow, such as protrusion of the oviduct. If trouble is experienced in this direction the forcing diet should be reduced by degrees until the trouble ceases. This is not to say that the whole flock should be kept back because the forcing diet has had an injurious effect on an odd bird or two. Poultry-keepers should use their own judgment in this respect.

There is, however, another, though more uncommon, cause of this part of the bird's anatomy becoming affected. It is frequently due to one or more birds in the flock acquiring the cannibal habit of picking at and puncturing the oviduct just when their mate is in the act of expelling her egg. As a result hæmorrhage sets in, and once this makes its external appearance after the bird leaves the nest it is soon attacked by its mates, with the result that the victim is caused a most cruel death. Indeed, due to both the causes referred to it is not uncommon to find dead birds in a house, where the other members of the flock have pulled out and eaten the greater part of the oviduct and intestines. On one plant where my advice was sought in regard to birds being found dead or bleeding from the vent, the owner informed me that he had lost four hundred pullets in a few months. He further informed me that from the commencement of the trouble all forcing foods had been eliminated from the ration. It was obvious to me, in view of past experience, that one or more members of the flock had acquired the cannibal habit referred to. Acting on my advice the owner immediately made the fronts of the nests deeper. The nests were also darkened by pieces of sacking tacked on to the front. In short, the nests were arranged in such a way that the culprit was unable to carry out its cannibal inclination. The owner has now advised me that from the time when he adopted preventive measures several months ago not a single bird has been lost from this cause.

CLEAN GROUND ESSENTIAL.

I cannot urge too strongly the importance of turning over every run possible, and sowing it down with a suitable green crop before the season becomes too late. This will not only have the effect of sweetening the soil and lessening the risk of disease and parasitic infection, but in addition the food thus grown will prove a valuable asset during the off season of the year. Moreover, such a run will make an ideal place for next season's young stock after they leave the brooder. The efficient poultry-keeper sees to it that his growing stock are always provided with a piece of clean ground to run on, and fully realizes that he is amply rewarded in the long-run for his trouble.

MORTALITY AMONG ARTIFICIALLY REARED CHICKENS.

Of late I have received many reports of heavy losses among chickens that were being artificially reared. In some cases the losses have been put down to some mysterious disease, while in others the particular make of brooder or brooders being used has been held responsible. It is true that the most experienced men in the business of poultry-keeping have much to learn in regard to artificial rearing, and it is only to be expected that the layman, or even the person with

some experience who does not possess a special aptitude in the work of brooder-management, will fail to always rear chickens with success. In the case of some of the plants where I have been requested to investigate the cause of the mortality I am fully convinced that improper management was solely responsible, and that the so-called epidemics did not exist; moreover, that the brooders being used were by no means at fault. It was the common fault of blaming everything but one's own understanding of the essentials which go to make success.

In the work of artificial chicken-rearing the point should never be lost sight of that the best brooder ever manufactured, or the best set of instructions ever framed, will fail to spell success if the person in charge of the rearing operations is incapable of thinking out things for himself and applying the knowledge of the necessary work which is now available. It is now generally recognized that to successfully manage poultry in large numbers the poultry-keeper must be a person of many parts. I have in my mind's eye men who have mastered to a high degree the important essentials regarding feeding, mating, culling of stock, &c., but who have sadly failed to rear the necessary chickens for the renewal of stock. There are so many things responsible for unsuccessful rearing by artificial means that it is necessary to look for the cause in many quarters. It is now too late, however, to talk of this for the present season.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

EXTRACTING.

EXTRACTING should now be in full swing in all districts. Where operations for any reason have been delayed care must be taken to see that the bees are not crowded out, or they will commence to loaf, and the ultimate crop will be small. It is good policy to extract twice during the season, but where the beekeeper prefers to leave the work until the end of the flow a close watch should be kept so as to provide ample room. This, however, can only be done where large numbers of spare combs are kept on hand. It is during the season when honey is coming in freely that the beekeeper realizes that his most valuable asset next to his bees is a good stock of extracting-combs. Every effort should be made to get at least twenty spare combs for each hive in the apiary, and with this number always on hand the bees are not likely to be hampered for room.

In the absence of plenty of drawn-out combs the best plan is to keep the extractor going, and thus prevent the bees from blocking the brood-combs. This usually happens unless ample room is provided, and as a result the queens are prevented from laying to their utmost and the colonies dwindle. At no time during the working season should the work of the queen be hindered. Care must be taken at all times to see to this important item during the flow. The honey is quite ready to extract when the combs are a half to three-parts capped, but great care must be exercised not to extract unripe honey. Numerous instances have come under my notice where the practice of taking unripe honey has meant a total loss to the beekeeper.

Removing Honey from the Hive.

The usual practice followed when the time for extracting is at hand is to remove the frames one by one. If excluders are used much time will be saved in picking over the combs. As the combs are taken from the hive shake the bees in front of the hive, brush off the remaining bees, and place the combs in a super for removal to the honey-house. The combs should be covered with a cloth which has been previously placed in water containing a small proportion of carbolic acid. When the season is at its height very little trouble will be experienced from robbers, but in case of a stoppage in the flow the foregoing precaution is necessary. At all times the beekeeper should study his working equipment, and this is specially important when removing the honey. It will be found convenient to provide a good barrow or truck for carrying at least two full supers. Much time and labour will be saved in this way, and the tedious work of removing the honey will be facilitated.

Uncapping.

One of the most important processes in the work of extracting is that of uncapping. There are several kinds of knives for the purpose on the market, but the stiff-bladed double-edged Bingham is usually first favourite. Two of these are necessary, and they must be stood in a pan of water which is kept boiling on a small lamp. Each knife as it becomes cold is returned to the boiling water and the hot one takes its place. Any contrivance which is used for an uncapping-can should be provided with a cross-bar through which to pass a screw or similar article, driven point upwards, to form a pivot on which to rest and revolve the combs. The comb should be placed with one end resting on the pivot and tilted slightly forward, in order to allow the cappings to fall away from the comb. Uncapping should commence at the bottom of the comb, and proceed with a sawing motion from side to side until the top of the comb is reached. The comb is then swung round on the pivot and the reverse side treated in the same manner. Only a thin sheet of wax should be removed, but it must be done thoroughly so that every cell is opened, and at the same time the top and bottom bars should be relieved of any burr-combs which may adhere to them.

A contrivance much in favour with progressive beekeepers is the steam-heated knife. This is a Bingham knife with a soldered copper plate, so arranged that steam is forced through it from a rubber tube attached to the spout of a "bronchitis" kettle. An escape-tube is fitted to the opposite side, and the knife is kept at a very high temperature all the time uncapping is proceeding, thereby obviating the work and trouble of continually plunging the knives into boiling water. For uncapping heavy fully capped frames it has no equal, since an ordinary uncapping-knife becomes cold as a rule before half one side of a full comb has been uncapped.

Strainers.

It is not uncommon to find exposed for sale honey with which proper care and attention have not been paid to straining at the time of extracting. Nothing deters the sale of extracted honey so much as a layer of wax-particles, dead bees, &c., and it is surprising how few beekeepers take the necessary trouble to see their product reaches the

customer free from wax and other impurities. In no case should honey be run direct from the extractor into the containers; it should be properly strained. It is the attention paid to this necessary detail that aids in the sale of the crop, and when honey is properly treated it readily commands a higher price. Fine-gauge wire strainers are usually adopted, but even these are not sufficient to remove the smaller wax particles. In order to ensure perfect condition the honey should be passed through good fine cheesecloth before being run into the tank. Cheesecloth strainers are excellent, cheap, and are easily made, while at the same time they can be readily cleansed. They remove everything but the smallest particles of wax, which should be finally disposed of when the honey is skimmed. This latter process is an important one, and should always be carried out before the honey is put up in marketable form.

SUPERSEDING QUEENS.

All old and failing queens should be superseded. It is a good plan to utilize surplus queens carried over in the nucleus hives to do the work. When due attention is given to requeening the apiary there is less likelihood of queenless hives in the spring. Remove all old queens in the apiary, and especially guard against wintering any colonies not headed by a vigorous mother.

TREATMENT OF FOUL-BROOD.

As advised last month, no effort should be spared to treat all colonies known to be affected with foul-brood. If the work is delayed the colonies will not build up to sufficient strength to winter safely. Under no circumstances should the work be put off. Treat all infected stocks while the flow is on, and endeavour to winter none but clean colonies. There is a great risk of spreading the disease to clean colonies in the off season, as robbing is more apt to break out. "Keep your bees clean" should be the maxim of every beekeeper. Where any doubt exists as to the complete absence of foul-brood in the apiary an excellent plan is to mark all combs with the number of the hives to which they belong, so that when extracted they may be returned to the colony from which they were taken. If this plan is followed, even if any of the hives are diseased, the risk of spreading infection by means of wet combs will be considerably reduced.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

THE TOBACCO HARVEST.

DURING February tobacco crops that were put out early in the season will commence to show signs of ripening. This is indicated by the green colour of the leaf gradually turning a paler shade, and decided yellow spots appearing between the main veins—in the lower leaves first—and gradually spreading to those higher on the stem. When the leaves half-way up the stem show these signs of ripeness the first suitable opportunity should be taken to harvest the crop.

In the past it has been customary to harvest the plants by splitting the stems nearly to the ground, then cutting them off at the surface of the ground and threading them on the curing-stick. The fresh sap thus exposed was a suitable medium for spores of moulds and other fungi, which often established themselves very quickly and spread to the leaves. This trouble has lead to another system being sometimes adopted, which is to split the stems when the middle leaves are ripe, and then to allow the plants to remain standing for three to four days to allow the exposed sap to dry off before harvesting.

The more general way now, however, is to cut the plants off at the surface of the ground and to hang them on the curing-stick by tying the butts of two plants together. A curing-stick is about 4 ft. 3 in. in length. The stick is placed on tier poles, which run like parallel bars in the curing-shed. There they should be placed about 1 ft. apart to allow a draught of air to pass between the hanging plants. Later, as the plants dry the sticks may be closed, and thus provide more accommodation. The tobacco, however, must not be crowded, but enough space allowed to prevent plants touching. Also special care must be taken to carry out these operations without bruising or breaking the leaves.

It is important not only that the surface of the plants should be dry when harvested, but that the work should be done in fine weather, when the leaves are charged with the natural secretions that give the product its value, as during showery weather these are washed out by excessive transpiration.

A curing-shed charged from floor to ceiling with plants hung in this manner soon has a warm humid atmosphere at this season of the year. Under such circumstances the leaves gradually turn a yellow colour, when more air should be admitted to dry them off. This has to be done thoroughly, and special care should be taken to dry out the main stem of each leaf, for when this process is incomplete moulds are almost sure to develop in that area when the leaf is baled for marketing.

TOMATOES.

The end of the indoor tomato crop is usually reached during February, and the harvesting of the outdoor crop is then well under way. It is very bad economy to allow the glasshouses to remain empty and neglected at this period; they should be heavily fumigated and cleaned up without delay. A green cover-crop of quick growth should then be sown with a view to following up with crops of winter lettuce, which are now becoming more popular, or sowing down seed-beds of lettuce, cabbage, cauliflower, and onions for planting out in the spring.

The outdoor tomato crop will now probably require feeding to enable the plants to bring the crop to full maturity. In this application it will probably be beneficial to include a proportion of nitrogenous fertilizer. For two or three months the packing and selling of this crop will keep the grower busy. The method of delivering this product to the public has not always been of the best, and it is interesting to note that a conference of growers is about to be held, when this phase of the subject will doubtless be dealt with. Anything that will facilitate and expedite business with this perishable article should be

done, as there is a wonderful demand for tomatoes if they can be supplied regularly in a suitable manner. The subject of tomato by-products also requires more attention to enable the scandalous waste which sometimes occurs to be turned to use and profit.

BERRY FRUITS.

Between the rows of raspberries, currants, gooseberries, &c., it is sometimes customary to sow now a green cover-crop to turn in during the winter, and such a crop has the merit of smothering weeds as well as providing humus. The above-mentioned berry plants are often found affected with disease and in a starved condition. Plants affected with insect and fungus troubles should now be dealt with by suitable spraying. The starved condition of these bushes is too often due to deep ploughing and cultivation cutting up the fibrous roots which lie near the surface. Such treatment is very damaging to these crops, and specially so if it is done during the growing season.

Much the same remarks apply to the strawberry-beds. The runners, old leaves, and mulch should now be cleaned up and burnt, and the plants given suitable manures. In fine weather hoe the ground at suitable intervals to keep weeds under control.

In the Auckland District beds planted close in May or June bear heavy crops in the following November and December, the plants being afterwards ploughed in. In other districts where soil and climate are different the more conventional method of planting in early autumn and cropping the beds for four years is preferred. Where planting is to be done it should be carried out as soon as possible. It is important that the land should be rich, clean, firm, and smooth before planting; 9 in. between the plants and 2 ft. to 3 ft. between the rows is the usual spacing. Plants set now should make fine autumn growth and be in excellent condition for cropping next spring.

Where it is purposed to plant bush fruits during the coming planting season commencing in May, the land should be selected and prepared by subsoiling and manuring. There is no reason why it should not also carry an autumn crop of vegetables meanwhile, and so help pay for the cost of cleaning.

THE MARKET-GARDEN.

Important crops that are started this month are cabbage and cauliflower for spring cutting, and autumn onions for planting out in early spring. These are some of the most important crops in this section, and demand careful attention. A piece of land well drained and sheltered should be chosen for these seed-beds. They should be sown about the end of the month—rather earlier in southern districts and later in the North. A sowing now of lettuce and parsley will also be profitable in many instances.

Winter crops planted last month should be cleaned and fed occasionally to obtain good growth. The celery crop especially must not be allowed to become dry or stand still. Also feed well asparagus and rhubarb crops now making a recovery from the crop of sticks drawn during spring and early summer.

Harvest crops as soon as they mature, and follow up with another crop, even if it is only a green cover-crop. Autumn-sown onions will

now be ripening; their value depends very much on how they are harvested. They suffer very quickly if stored in a close atmosphere; they demand very dry, airy conditions to keep them well.

NATIVE PLANTS IN A NEW PLYMOUTH GARDEN.

It would doubtless be mistaken enthusiasm to recommend that a New Zealand garden should be confined to native plants, but there can be no doubt that every native plant of real use or interest should be given preference in the home garden and suitably displayed. If this were done native evergreens—than which there are none better—would take the place of the laurels and euonymus, &c., that are at present commonly planted. The karaka (*Corynocarpus laevigata*) makes an evergreen hedge that compares more than favourably with the cherry-laurel. It should be planted 2 ft. to 3 ft. apart, and the hedge kept narrow; it then makes an unbroken wall of foliage that is both ornamental and useful when rightly placed.

During a recent visit to New Plymouth some native plants were seen growing that are well worth noting. One of the most attractive was mairehau (*Phebalium nudum*), a shrub growing 6 ft. to 8 ft. high, that has not only a graceful appearance, but is very highly scented in all its parts. In a garden of any size a group of these plants would be a decided feature. In a native state it appears to be confined to the hilly forests of Auckland Province, but, like many such plants, it appears to thrive much farther south where it has the shelter of an established garden.

Another highly perfumed native plant growing there was the koheriki (aniseed—*Angelica rosaefolia*), highly appreciated by shepherds as well as their flocks. In fact, stock are so fond of it that it is becoming scarce in a wild state, and shepherds often dry the leaves and rub them up in their tobacco to give it an aroma. Koheriki is a little plant 1 ft. to 2 ft. in height that is very suitable on rock-work in the open.

Parapara, the bird-catcher (*Pisonia Brunoniana*) is an evergreen with long handsome leaves and long narrow fruits that are extremely viscid, so much so that the smaller birds visiting the tree are often held prisoner. This tree, which grows to about 12 ft. in height, is suitable only for the warmer localities.

An attractive herbaceous plant with wide grass-like leaves and large light sprays of white flowers is rengarenga, the rock-lily (*Arthropodium cirratum*). It grows to a height of about 3 ft., and planted in a fairly large group in the foreground it cannot be overlooked.

These are mentioned here because the planting season is approaching. Planters who are now studying the subject in preparation for future action will no doubt appreciate these notes, which deal with our native plants from the point of view of their value in the home garden.

—W. C. Hyde, Horticulturist, Wellington.

Orchard-tax Act.—By notice gazetted on 6th December, 1928, the Hawke's Bay and the Thames Commercial Fruit-growing Districts, declared as such pursuant to the provisions of the Fireblight Act, 1922, are made subject to section 4 of the Orchard-tax Act, 1927.

TESTING OF PUREBRED DAIRY COWS.

DECEMBER CERTIFICATE-OF-RECORD LIST.

Dairy Division.

IN December, 1928, seventy-six certificates were issued under the C.O.R. system. Details of the records are given in the following list:—

* Cow milked three times daily during whole lactation period. † Milked three times daily during part of period

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	JERSEYS.					
Junior Two-year-old.		Yrs. dys.	lb.		lb.	lb.
Elcho Hope ..	C. J. Masters, Hunterville	2 12	241·7	365	9,842·5	574·85
Ivondale Silver Rainbow†	P. J. Petersen, Waitara ..	1 351	240·5	365	10,040·8	571·70
Elcho Catherine ..	C. J. Masters, Hunterville	1 361	240·5	365	8,202·5	552·98
AbberleyGolden Flower	J. O'Donnell, Bunnythorpe	2 14	241·9	365	9,121·3	542·70
Ngahiwi Nancy Lee ..	W. J. Freeth, Pukearuhe ..	2 20	242·5	365	8,968·7	537·39
Pinewoods Golden Stella	G. H. Bell, Oakura ..	1 325	240·5	365	8,425·6	533·64
Ngahiwi Bilberry ..	W. J. Freeth, Pukearuhe ..	1 347	240·5	365	8,439·2	520·18
Pinewoods Viola's Beauty	G. H. Bell, Oakura ..	2 9	241·4	365	8,039·9	518·60
Abberley Sunflower ..	J. O'Donnell, Bunnythorpe	2 7	241·2	365	8,281·5	514·23
Ngahiwi Chalm ..	W. J. Freeth, Pukearuhe ..	1 343	240·5	365	8,733·6	514·13
Te Ngutu Nellie ..	J. Murray, Woodville ..	1 20	240·5	365	9,562·2	514·13
Elcho Xenia ..	C. J. Masters, Hunterville ..	1 363	240·5	365	8,616·5	510·26
Ngahiwi Waif ..	W. J. Freeth, Pukearuhe ..	2 3	240·8	353	8,625·2	487·21
Majesty's Figurehead	H. Allen, Kihikihi ..	1 237	240·5	365	7,792·4	485·38
Ngahiwi Lady Retford	W. J. Freeth, Pukearuhe ..	2 50	245·5	349	7,660·9	476·37
Ngahiwi Romance's Pet	W. J. Freeth, Pukearuhe ..	1 364	240·5	365	7,933·0	472·42
Pari Light	F. C. Butt, Opotiki ..	1 337	240·5	365	8,168·7	466·80
Hua Brook Sirona ..	H. Salway, Bell Block ..	2 71	247·6	365	8,559·3	427·25
Crofton Isabelle ..	Dr. C. G. Aickin, Auckland	2 30	243·5	365	7,246·7	427·23
Hua Brook Pride ..	H. Salway, Bell Block ..	1 311	240·5	364	8,125·3	417·64
Raeburn Briar ..	J. S. Rae, Taneatua ..	1 354	240·5	365	7,370·4	402·58
Patch's Wonder ..	H. R. Lancaster, Palmerston North	2 35	244·0	365	6,897·7	402·06
Runnymead Happiness	L. R. Fuller, Greenmeadows	2 13	241·8	365	7,209·8	387·62
Glenview Primrose ..	R. A. Paddon, Pukeatua ..	2 1	240·6	365	7,450·1	386·68
Jersey Meadows Fancy	L. R. Fuller, Greenmeadows	1 360	240·5	365	6,428·3	376·33
Tauwhare Claudia ..	Dr. C. G. Aickin, Auckland	2 37	244·2	365	6,675·3	363·54
Otterburn Blue Bell ..	G. Taylor, Point Chevalier	1 289	240·5	345	6,494·3	362·21
Vernon Xenia's Lady Supreme	G. R. and H. Hutchinson, Auckland	1 327	240·5	356	6,326·0	347·67
Velebit Kestons V.C.*	G. E. Yelchich, Waiuku ..	1 258	240·5	301	6,851·5	337·72
Lammermoor Belle ..	M. G. McArthur, Auckland	2 20	242·5	305	5,924·3	336·55
Hero's Ruby ..	R. A. Paddon, Pukeatua ..	2 6	241·1	361	6,845·6	332·42
Pinewoods Golden Patch	G. R. and H. Hutchinson, Auckland	2 2	240·7	365	5,881·2	320·91
Green View Dot ..	G. Taylor, Point Chevalier	1 323	240·5	326	5,088·8	310·55
Corra Lynn Rose ..	A. Best, Bombay	1 206	240·5	365	4,717·2	273·47
Senior Two-year-old.						
Pinewoods Violas Silvery	G. H. Bell, Oakura ..	2 364	278·6	365	9,476·8	553·14
Palmdale Shirley ..	D. Kennedy, Morven ..	2 305	271·0	336	9,299·6	471·98
Ratoma Winnie ..	J. S. Rae, Taneatua ..	2 334	273·9	352	6,908·9	445·56
Sunhill Lovecharm ..	J. G. Holmes, Te Awamutu	2 193	259·8	365	7,498·0	416·14

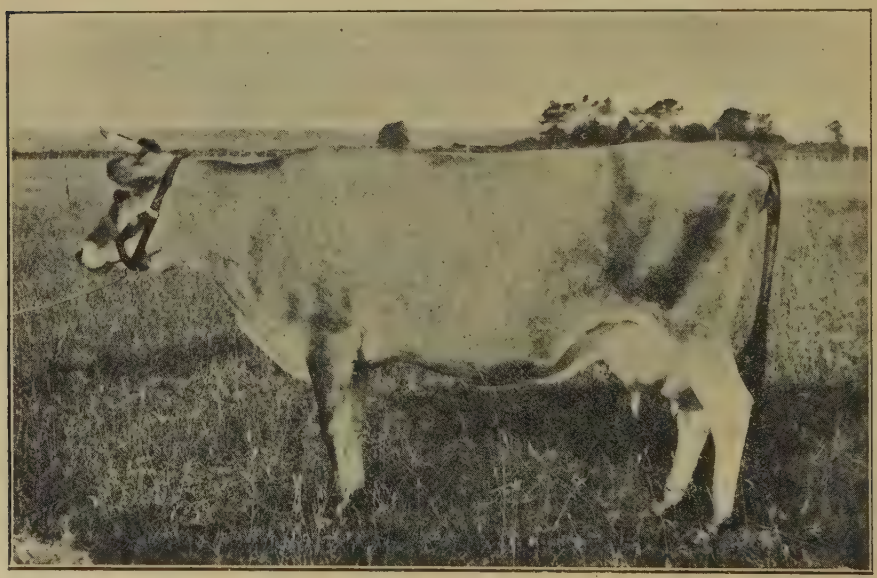
LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	JERSEYS—*continued.*					
Three-year-old.		Yrs. dys.	lb.		lb.	lb.
Carhuduff Silver Lily	J. O'Donnell, Bunnythorpe	3 359	312·9	365	11,810·0	685·29
Ashley's Gem ..	W. T. Dazeley, Pukekohe ..	3 359	312·9	365	10,057·3	617·60
Raeburn Pansy ..	J. S. Rae, Taneatua ..	3 192	296·2	365	9,250·6	566·48
Tauwhare Daisy ..	Dr. C. G. Aickin, Auckland	3 363	313·3	348	7,964·2	501·20
Laurelette* ..	G. E. Yelchich, Waiuku ..	3 359	312·9	365	7,566·7	474·01
Hua Brook Jolly Queen	H. Salway, Bell Block ..	3 16	278·6	365	8,028·5	473·07
Dorothy of Westown	R. A. Paddon, Pukeatua ..	3 26	279·6	365	8,995·6	435·43
Ferndale Briar's Lady	J. J. Springgay, Gisborne ..	3 31	280·1	307	8,096·3	434·20
Ivondale Sun Queen ..	H. Salway, Bell Block ..	3 290	306·0	365	9,649·7	411·70
Four-year-old.						
Belvedere Gold Plume	Dr. C. G. Aickin, Auckland	4 346	348·1	365	11,832·6	614·66
Fury's Lucinda ..	H. Salway, Bell Block ..	4 265	340·0	365	8,649·8	562·33
Tauwhare Fairy Girl	Dr. C. G. Aickin, Auckland	4 44	317·9	365	8,460·8	457·58
Tauwhare Faith ..	Dr. C. G. Aickin, Auckland	4 2	313·7	364	8,503·0	455·72
Sweet Juno's Pet ..	A. J. Harris, Bombay ..	4 15	315·0	337	6,841·1	453·69
Maid of all Work ..	Dr. C. G. Aickin, Auckland	4 206	334·1	362	8,501·5	443·98
Tauwhare Ann ..	Dr. C. G. Aickin, Auckland	4 17	315·2	365	7,694·7	422·42
Maid of Tauwhare ..	Dr. C. G. Aickin, Auckland	4 359	349·4	365	6,253·5	377·68
Roslyn Swannie Fox	A. J. Harris, Bombay ..	4 52	318·7	365	5,458·7	334·11
Mature.						
Calyptra†	P. J. Petersen, Waitara ..	5 297	350·0	365	11,416·7	611·59
Blue Silk	C. G. Wardell, Opaheke ..	12 297	350·0	294	9,296·1	519·64
Holly Oak Trixie ..	Dr. C. G. Aickin, Auckland	5 30	350·0	365	9,048·7	488·57
Lady Erica ..	A. Best, Bombay	5 304	350·0	365	9,499·2	486·89
Peach Blossom ..	C. G. Wardell, Opaheke ..	8 324	350·0	293	7,633·5	480·68
Royal Lass	J. S. Rae, Taneatua ..	6 286	350·0	340	9,222·3	457·95
Tecoma Primrose ..	M. G. McArthur, Auckland	6 79	350·0	365	9,384·3	448·01
Plum Blossom ..	C. G. Wardell, Opaheke ..	8 358	350·0	258	6,729·6	436·22
Creme de la Creme ..	Dr. C. G. Aickin, Auckland	5 348	350·0	365	7,191·7	424·16
	FRIESIANS.					
Junior Two-year-old.						
Hanley Clover Omega*	G. H. Hassall, Clarkville ..	1 346	240·5	365	16,225·9	535·54
Dominion Lady Domino Woodcrest	Central Development Farm, Weraroa	1 345	240·5	329	9,765·4	348·07
Senior Two-year-old.						
Fendalton Belle Posch 2nd*	J. I. Royds, Christchurch ..	2 226	263·1	282	8,082·8	277·58
Senior Three-year-old.						
Mahoe Myrtle Pontiac	R. A. Wilson, Bulls ..	3 269	303·9	361	11,095·5	436·03
Junior Four-year-old.						
Pareora Van Thumper Posch*	A. S. Elworthy, Timaru ..	4 29	316·4	365	14,481·6	516·49
Senior Four-year-old.						
Colinton Vida* ..	L. H. Leslie, Bennett's ..	4 311	344·6	365	19,294·9	640·06
Mature.						
Colinton Pietje Lass*	L. H. Leslie, Bennett's ..	5 13	350·0	365	18,010·6	570·77

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
		Yrs. dys.	lb.		lb.	lb.
MILKING SHORTHORNS.						
Junior Three-year-old.						
Mereside Gem 1st* ..	W. Bowis, Doyleston ..	3 38	280·8	365	7,855·6	334·46
Second-class Certificates.						
Jerseys.						
Junior Two-year-old.						
Hurden Fawn Beauty	H. Allen, Kihikihi ..	2 27	243·2	365	9,669·8	626·08
Glenview Madge ..	R. A. Paddon, Pukeatua ..	1 340	240·5	365	7,691·2	442·46
Meadowvale Florist	J. G. Holmes, Te Awamutu	1 358	240·5	365	7,519·4	420·76
Friesians.						
Mature.						
Bainfield Topsy 14th*	J. I. Royds, Christchurch ..	6 312	350·0	365	20,606·9	785·30

NOTE.—Ashley's Gem, appearing above in the Jersey three-year-old class, was inadvertently included in the four-year-olds as published in the November, 1928, *Journal*, and is now correctly listed.



WAIUKU DAWN (W. CRAIG, WAIUKU).

C.O.R. in Jersey Junior Two-year-old class: 10,023·7 lb. milk, 630·68 lb. butterfat.

STATISTICS OF PASTURE TOP-DRESSING ON FARMS, 1927-28.

Land District.	Superphosphate.		Basic Slag.		Other Artificial Fertilizers.		Stable and Farm Manure.	Lime.	
	Area.	Quantity applied.	Area.	Quantity applied.	Area.	Quantity applied.	Area.	Area.	Quantity applied.
	Acres.	Cwt.	Acres.	Cwt.	Acres.	Cwt.	Acres.	Acres.	Cwt.
North Auckland	160,021	457,447	67,214	218,834	47,636	149,817	827	7,378	56,379
Auckland	637,502	1,660,308	52,666	178,709	66,288	201,258	654	15,340	95,892
Gisborne	24,658	55,901	1,138	3,853	1,157	2,854	41	345	1,470
Hawke's Bay	74,808	166,631	3,154	7,434	4,589	10,260	9	1,710	11,309
Taranaki	111,104	273,611	104,649	273,235	14,789	39,463	313	9,317	28,628
Wellington	172,142	411,038	33,353	93,963	21,188	51,647	335	13,199	82,406
Nelson	14,942	32,229	2,041	4,813	728	1,629	79	1,678	27,456
Marlborough	14,146	25,065	172	321	284	513	28	321	2,576
Westland	2,697	6,503	36	177	877	2,085	93	841	6,788
Canterbury	41,160	72,431	887	1,761	3,464	5,594	393	5,345	39,495
Otago	36,518	73,026	2,600	6,916	7,488	22,256	272	16,422	197,893
Southland	79,352	171,618	9,057	22,679	16,711	46,155	106	46,228	480,986
Totals, 1927–28	1,369,050	3,405,808	276,967	812,695	518,199	533,531	3,150	118,124	1,031,278
Totals, 1926–27	985,162	2,353,550	262,768	758,769	161,859	482,648	4,475	106,995	788,035

NOTE.—In cases where farmers top-dressed the same areas with two or more of the fertilizers quoted, either separately or as a mixture, duplication of such areas under the appropriate fertilizer headings may have resulted. Consequently the actual total area top-dressed would be somewhat less than the sum of the areas appearing under the individual fertilizer headings.

—*Census and Statistics Office.*

REVIEW.

The Trees of New Zealand, by L. COCKAYNE, Ph.D., F.R.S., and E. PHILLIPS TURNER, F.R.G.S. New Zealand State Forest Service. 171 pages, 118 illustrations. Government Printer, Wellington. Price 4s. (cloth-bound copies extra).

ISSUED in the first place for the benefit of delegates to the Third British Empire Forestry Conference, 1928, this little volume admirably serves the further purposes aimed at by the authors. It enables the lovers of our indigenous trees—and they are many—to recognize them at once, whether they meet them in the wild or in the garden. They will find also authoritative accounts of the distribution and uses of the trees. The reviewer echoes the hope expressed in this sentence of the preface: "We also trust that it will come into the hands of many teachers of nature-study, and, above all, the senior pupils in schools, so that the latter may come to understand clearly what a priceless possession are these forests of theirs with the trees pure New-Zealanders, and that with such knowledge will arise a fixed determination that the areas of forest and other vegetation set aside as national parks, scenic reserves, and sanctuaries shall never be desecrated, but remain far into the distant future living examples of primeval New Zealand." The writer would like to see copies of the book placed in every primary school in the land, and especially in the smaller country ones.

Although botany is the Cinderella of the sciences taught in our secondary schools—a remarkable fact, when we pause to consider its importance for our economic welfare no less than our culture—Cinderella may yet come into her own, and this book would go a long way towards helping the scholars to help themselves to a knowledge of those "pure New-Zealanders"—our trees. "Notwithstanding the tropical character of the forest," say the authors, "how purely a New Zealand production it is may be seen from the fact that, leaving the ferns and their close relatives on one side, no less than 89 per cent. of the species [and we are told there are 290] are endemic, and if the ligneous plants be alone considered, all are pure New-Zealanders except three."

Chapter I deals summarily but interestingly with the general characteristics of our forests, which are stated to fall into two distinct subdivisions—subtropical rain-forest and subantarctic rain-forest. Accounts are given of the various groups to be found within these subdivisions—*e.g.*, coastal forest and swamp-forest. The factors influencing the composition of the forest, and the changes that occur as one travels from north to south and from coast-line to mountain-top, are explained, and statistics given of the component species. The absence from primitive New Zealand of grazing and browsing mammals is emphasized and its bearings discussed. All this will whet the appetite for more, but we are not told where further details may be found. Readers who wish to go deeper might start with "New Zealand Plants and their Story," and will find a full account in "The Vegetation of New Zealand," both from the pen of Dr. Cockayne.

Chapter II—the outstanding feature of the book—consists of a series of illustrations of 106 trees (mainly specimens of leaves, flowers, and fruit), accompanied by concise technical accounts of their characters and a statement of the distribution of each. Any one scared by the spectre of "technical terms" will soon be able to exorcise this, after all, feeble bogy by the help of the excellent glossary at the end of the book.

Mr. S. Gibson is to be heartily congratulated on the exceptionally fine series of photographs. It would be captious, perhaps, to suggest that in some cases even better results might have been obtained by slight modification of the background. So good, indeed, are the illustrations that in very few cases—*e.g.*, some of the "pines" and coprosmas—will the inquirer need to do more than compare a living specimen with the photographs to arrive at its proper name. Both technical and Maori names are given, and in some cases the "popular" name. There are pitfalls, however, in every scheme devised to reduce wild nature to order. It may be noticed, for instance, that in Fig. 13 the description reads "leaves *alternate*" (as in all text-books), while the spray illustrated shows the

less usual but still not uncommon form with leaves to all intents and purposes "opposite." It is important for the user of the book to note the scale of enlargement indicated on each photograph.

The chapter concludes with a key to certain species not illustrated, remarks on hybridism with photographs of certain hybrid swarms, and a list of known hybrid groups among our trees, followed by a brief note on epharmony—changes in form in response to changes in environment. The key, as far as the reviewer has tried it, appears to "work" fairly well, but one needs flowering and fruiting specimens to "get there." A student finding trouble in placing a specimen should, after arriving at the illustration most nearly fitting his case, consult the list of hybrids, as the source of his trouble may be there revealed. So rapid is the advance in our knowledge of wild hybrid groups that about six more could already be added to the list here published. A suspect that has considerable interest, and is at present being investigated, is a tree that is probably *Podocarpus spicatus* x *totara*, recently discovered by Mr. G. V. Wild near Feilding. Space probably did not admit of a fuller discussion of epharmony, but an illustration of the great changes sometimes caused would have been useful—say, the remarkable case of *Nothofagus fusca* spoken of on page 146.

Chapter III deals with the timbers, and conveys a great deal of information in a short space. The authors limit themselves in this section to dealing with trees for the timber of which there is some demand. This certainly tends to induce a juster view of the relative importance of our trees from a timber-producing point of view, but one would have liked a little more detail concerning some of the trees dealt with, and of their other economic uses. Young farmers, especially, would have welcomed more information on the value of different trees from their point of view. Also very welcome would have been illustration of various sections of the timbers dealt with. But all this is really asking the authors for an additional book.

The glossary has already been mentioned, but the definitions of "vegetation" and "flora" on page 163, are specially recommended to the notice of newspaper reporters and "popular" writers in general.

The book is fittingly dedicated "To the Honoured Memory of Thomas Kirk, the author of the classical 'Forest Flora of New Zealand.'" That it will fulfil the aims and hopes of the writers is certain.

H. H. ALLAN.

AGRICULTURAL SHOWS, SEASON 1928-29.

THE following show-dates for the remainder of the season have been notified by agricultural and pastoral associations:—

Rangitikei A. and P. Association: Taihape, 23rd and 24th January.
Horowhenua A. and P. Association: Levin, 29th and 30th January.
Feilding A. and P. Association: Feilding, 5th and 6th February.
Tauranga A. and P. Association: Tauranga, 5th and 6th February.
Dannevirke A. and P. Association: Dannevirke, 12th and 13th February.
Te Puke A. and P. Association: Te Puke, 13th February.
Buller A. and P. Association: Westport, 15th and 16th February.
Masterton A. and P. Association: Solway, 19th and 20th February.
Whakatane A. and P. Association: Whakatane, 20th February.
Opotiki A. and P. Association: Opotiki, 23rd February.
Te Awamutu A., P., and H. Association: Te Awamutu, 20th February.
Taranaki Metropolitan Agricultural Society: New Plymouth, 6th and 7th March.
Morrinsville A. and P. Society: Morrinsville, 13th March.
Hawke's Bay A. and P. Society (Autumn Show): Tomoana, 20th March.
Mayfield A. and P. Association: Mayfield, 23rd March.
Methven A. and P. Association: Methven, 27th March.
Flaxbourne A. and P. Association: Ward, 18th April.

Correction.—In the first line of the section headed "catch-crops for green feed," on page 50 of this issue, the words "more humid" should read "sub humid."

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

PERENNIAL CANARY-GRASS (PHALARIS BULBOSA).

W. H. HOMER, Tasman :—

I would be pleased if you could give me any information regarding perennial canary-grass (*Phalaris bulbosa*), time to sow, &c.

The Fields Division :—

Phalaris bulbosa has been tried (mostly in small plots) in various parts of New Zealand, and in some of the colder districts, when sown on heavy land, it has done fairly well. It has been included in pasture mixtures in some cases, but results have not been good. Its period of growth is during the cooler part of the year, but prairie-grass has proved superior when grown under similar conditions. The rate of seeding of *Phalaris bulbosa* is about 15 lb. per acre, and sowing can take place from about 1st October until the end of the year. The land should be well rolled prior to sowing, and the seed should be covered with a light brush harrow. This grass responds well to a dressing of superphosphate, which should be applied at time of seeding at the rate of 2 cwt. per acre.

CROSSBREEDING OF MUSCOVY DUCKS.

ROY SLEEP, Penrose :—

Kindly inform me whether it is possible to cross Muscovy and Aylesbury ducks, as the former take five weeks to hatch and the latter four weeks.

The Live-stock Division :—

We have no first-hand knowledge that these two breeds will cross. It is, however, commonly known that the Indian Runner, Mallard, and other breeds of duck will cross with the Muscovy. In the circumstances there is good reason to believe that the Aylesbury and Muscovy would cross. It is claimed by some authorities that the crosses produced by the Muscovy with other breeds of ducks are sterile, but this contention does not hold good in all cases if the opinions expressed by various authorities can be relied upon.

TROUBLE WITH HONEY.

"X Y Z," Otane :—

After taking my honey last season, and straining it without heating, I put it into jars. It did not set hard, but about one-third at the bottom went sugary, leaving the remaining two-thirds a runny brown liquid. The bees had abundance of clover, and there is no manuka within a few miles of the hives. Kindly explain the altered condition.

The Horticulture Division :—

The fact of your honey having changed its condition as described indicates either a separation of the two main sugars which constitute honey—levulose and dextrose—or that the honey has been slightly fermenting. The condition may be due to the honey not being ripe when taken from the combs, or through not being stored in airtight vessels during the winter months. Honey readily absorbs moisture from the atmosphere if not kept in a dry place, and fermentation sets

up. You do not mention whether the "runny brown liquid" is sour or otherwise, and a sample of the honey would be necessary in order to give a definite explanation of its altered condition.

BASIC SLAG FOR SOUTH CANTERBURY GRASSLANDS.

W. SIMPSON, Waimate :—

I would be obliged if you could advise me if basic slag (17–20 phosphoric acid, 80 per cent. fineness) would be suitable for top-dressing grassland here, and if the results would be as satisfactory as with superphosphate 44–46. The price of slag is £4 per ton Dunedin. Our land is on the downs, two miles from Waimate, in the Waituna district.

The Fields Division :—

We feel sure that on the type of soil and with the climatic conditions obtaining at Waituna basic slag will give good results in top-dressing pastures. Comparatively little basic slag has been used in Canterbury so far, but where it has been used along the foothills country results have been most satisfactory. To get the best results slag should be applied in April or May.

COST OF STARTING POULTRY-FARMING.

"POULTRY," Puni :—

Would you please state what is the initial cost in housing and for the purchase of all requirements to start poultry-farming with 500 to 750 hens ?

The Chief Poultry Instructor :—

The initial cost of purchasing land, and of fully equipping a poultry plant sufficiently large to accommodate from 500 to 750 hens would depend to a great extent on local conditions. The price of land, building-material, &c., and whether the site is flat or otherwise would all have an important bearing on the initial cost of the proposed venture. Furthermore, no mention is made as to whether or not it is proposed to hatch the necessary stock on the plant, or stock it with day-old chicks or young pullets bred by another. However, from a general standpoint, to purchase suitable land and provide the necessary buildings and equipment, the initial cost should run from £1 to £1 5s. per bird.

PRESSING HAY DIRECT FROM FIELD.

R. B. N., Mount Somers :—

I would be grateful if you would give me some information regarding the pressing of hay direct from the field. (1) How long must the hay lie before being pressed to ensure against it becoming mouldy or heated ? (2) What is the best method of stacking the bales for storage purposes ? (3) What weight should be put into the bales if the hay has not been stacked ? (4) How long can pressed hay be stored and still retain its quality ?

The Fields Division :—

The system of pressing hay direct from the field has not proved altogether satisfactory in this country, such hay having often opened up in indifferent condition. However, under the best conditions and with proper technique some good results have been attained. In many cases the bales are too tightly pressed. If you decide to give the practice a trial it would be best to arrange for bales to be pressed somewhat loosely, which would necessitate three wires in place of two. Store in tiers where a good current of air can circulate around the bales. The weight of the bales should not exceed about 56 lb. If saved in really good condition and well protected from the weather, pressed hay should keep quite good for several years.

WEATHER RECORDS: DECEMBER AND CALENDAR YEAR, 1928.

Dominion Meteorological Office.

GENERAL NOTES FOR DECEMBER.

DECEMBER was a very wet month over much the greater part of the Dominion. About double the normal rainfall was recorded on the average over the North Island and in Canterbury, Nelson, and Marlborough. In many places it was the wettest December for many years, and in some the wettest on record. Westland, parts of Central and Northern Otago, and Southland proved exceptions to the rule, having rainfalls below the average.

There was again a marked absence of westerly winds, while southerlies were rather unusually prevalent. The low rainfalls in Westland and Otago were associated with the lack of westerly winds. Gales were few and winds generally light.

Though the southerly winds caused cool temperatures in parts of the eastern districts, conditions were, on the whole, mild and humid. Few places experienced any severe cold snaps. The month resembled its predecessor in the frequency of thunderstorms. These occurred most widely on the 1st, 15th, 16th, 23rd, 29th, and 31st, but were recorded in some places also on the 2nd, 5th, 6th, 9th to 14th, 20th, 24th, 25th, and 28th.

The tendency for depressions to be of cyclonic form which has characterized the whole year was no less evident in December. On three occasions cyclones developed in the northern portions of depressions as they were crossing the Dominion. The first of these was on the 9th, when the cyclone appeared to the westward of the North Island. The centre passed through Cook Strait on the 10th. Moving slowly and being reinforced by the development of secondaries, the cyclone remained off the east coast until the 15th, when it gradually moved away. Southerly winds set in on the 10th, and continued in most districts for the remainder of the spell.

Very wet weather prevailed throughout the whole period, especially from the 9th to the 14th. On the 9th heavy rain was very general. A very severe hail-storm occurred on the 11th in the Napier district, and did serious damage to fruit crops and trees on a narrow line extending from Eskdale through Greenmeadows to Pakowhai. At some places stones up to 1½ in. in diameter were observed. On the 13th, when the cyclone became very intense, southerly gales were experienced at some places, temperatures dropped, and snow fell on the mountain-tops in both Islands. The period was reminiscent of that between the 12th and the 19th of December, 1927, when, however, the cyclones were centred farther eastward. Last year, also, the southerly winds were more severe and temperatures lower.

A rather intense depression moving from the westward caused northerly gales in Cook Strait and rain from Taranaki and Wellington southwards on the 19th. The second cyclone, which, however, was of only slight intensity, developed in the northern portion of this depression on the 20th.

The third cyclone followed the passage of a southern depression on the 24th. Its centre was in the far northern portion of the Tasman Sea, and did not pass away to the eastward until the 29th. This storm was responsible for very wet weather during the holiday season. Heavy and general rains were experienced in almost all districts, especially on the 25th or 26th and the 28th. Low-pressure waves of the westerly type kept the weather unsettled, especially in the South Island, until the end of the month.

—Edward Kidson, Director of Meteorological Services, Wellington.

RAINFALL FOR DECEMBER AND CALENDAR YEAR, 1928, AT REPRESENTATIVE STATIONS.

No.	Station.	December, 1928				Calendar Year.	
		Total Fall.	Number of Wet Days.	Maximum Fall.	Average December Rainfall.	Total Rainfall, 1928.	Average Rainfall
	North Island.	Inches.		Inches.	Inches.	Inches.	Inches.
1	Kaitaia	5·00	11	2·00	3·28	59·55	50·87
2	Russell	4·79	13	2·25	2·65	54·01	51·79
3	Whangarei ..	5·73	16	1·04	3·11	79·60	61·75
4	Auckland ..	6·00	15	2·10	2·84	59·27	44·18
5	Hamilton ..	4·88	12	1·60	3·72	55·80	50·36
6	Kawhia	6·56	13	2·16	3·25	56·51	53·98
7	New Plymouth ..	8·10	15	2·82	4·33	57·25	60·35
8	Riversdale, Inglewood	9·36	18	2·63	7·43	91·71	104·48
9	Whangamomona ..	6·50	10	1·00	5·84	72·27	79·65
10	Eltham	6·37	12	1·83	3·83	56·34	52·43
11	Tairua	9·00	13	2·52	4·68	84·31	67·18
12	Tauranga ..	8·92	16	2·58	3·47	61·74	53·10
13	Maraehako Station, Opotiki	5·45	9	2·75	2·74	51·37	52·82
14	Gisborne ..	6·44	11	3·38	2·16	50·66	46·94
15	Taupo	..	..	..	3·36	..	45·10
16	Napier	4·82	15	1·51	2·30	36·34	36·41
17	Maraekakaho Station, Hastings	4·94	18	1·34	2·21	41·39	34·81
18	Taihape	6·10	18	2·55	3·42	37·98	40·01
19	Masterton ..	6·44	16	1·53	2·80	46·23	38·71
20	Patea	5·00	17	1·35	3·67	43·46	45·19
21	Wanganui ..	5·58	11	1·98	2·63	34·32	36·68
22	Foxton	5·74	12	1·30	2·54	37·11	31·88
23	Wellington (Karori)	8·82	16	2·41	2·99	62·01	45·24
	South Island.						
24	Westport ..	8·37	20	2·75	6·60	83·59	78·27
25	Greymouth ..	6·75	15	1·36	8·56	89·46	99·42
26	Hokitika ..	8·88	19	1·76	10·70	116·21	116·59
27	Ross	11·18	12	2·95	12·04	143·18	136·86
28	Arthur's Pass ..	8·31	10	2·12	14·93	165·58	156·61
29	Okuru, Westland ..	6·76	8	2·00	11·73	148·46	148·32
30	Collingwood ..	9·04	14	3·06	8·01	92·71	99·81
31	Nelson	8·69	15	2·26	2·69	41·21	37·84
32	Spring Creek, Blenheim	5·06	9	1·62	2·04	34·54	30·59
33	Tophouse ..	9·23	14	2·05	5·66	65·99	61·85
34	Hanmer Springs ..	9·41	16	2·49	3·28	57·59	41·01
35	Highfield, Waiau ..	7·80	14	1·76	2·58	34·65	33·56
36	Gore Bay ..	5·14	16	1·23	2·77	38·70	31·21
37	Christchurch ..	6·00	14	1·41	2·06	23·77	25·30
38	Timaru	4·22	17	0·88	2·41	22·58	22·78
39	Lambrook Station, Fairlie	5·70	14	0·90	2·58	26·49	24·98
40	Benmore Station, Clearburn	3·53	14	0·78	2·13	30·46	24·79
41	Oamaru	3·62	12	0·86	2·15	20·52	21·82
42	Queenstown ..	2·05	13	0·80	2·59	35·58	30·64
43	Clyde	1·96	10	0·58	1·79	16·68	15·23
44	Dunedin ..	3·88	16	0·90	3·48	30·15	36·96
45	Wendon	3·13	12	0·98	2·76	30·22	30·27
46	Gore	3·15	14	0·97	3·33	34·35	34·41
47	Invercargill ..	3·43	17	0·80	4·26	43·71	45·98
48	Puysegur Point ..	5·00	20	1·12	6·63	99·58	83·61
49	Half-Moon Bay, Stewart Island	2·60	10	0·90	5·69	58·89	58·70

LATEST EXPORT EXAMINATION DATES FOR APPLES.

Following are the latest dates of receiving at inspection points for export fruit the respective varieties of apples grown in the districts specified :—

1. Varieties in Alphabetical Order.

Variety.	Auckland.	Gisborne and Hastings.	Marlborough.	Nelson Province.	Wairarapa and Canterbury.
Adams Pearmain	15 Mar.	23 Mar.	23 Mar.	29 Mar.	12 April
Alfriston	5 ,,	5 ,,	8 ,,	11 ,,	21 Mar.
American Horn	20 April	20 April	22 April	25 April	30 April
Baldwin	25 Mar.	25 Mar.	31 Mar.	3 ,,	12 ,,
Ballarat Seedling	10 May	10 May	10 May	10 May	12 May
Blenheim Orange	2 Mar.	5 Mar.	7 Mar.	17 Mar.	20 Mar.
Boston Russet	18 ,,	18 ,,	31 ,,	3 April	10 April
Brighton	12 May	12 May	12 May	12 May	12 May
Brownlee's Russet	10 April	10 April	20 April	25 April	30 April
Celo	3 May	3 May	3 May	3 May	12 May
Cleopatra	5 April	5 April	5 April	12 April	12 April
Cox's Orange	4 Mar.	4 Mar.	14 Mar.	14 Mar.	25 Mar.
Crofton	10 May	10 May	10 May	10 May	12 May
Delicious	12 April	12 April	16 April	16 April	20 April
Dougherty	12 May	12 May	12 May	12 May	12 May
Dunn's	31 Mar.	31 Mar.	7 April	7 April	18 April
Edward Lippiatt	20 April	20 April	20 ,,	25 ,,	30 ,,
Frimley Beauty	30 ,,	30 ,,	30 ,,	3 May	5 May
Golden Pippin	28 Feb.	28 Feb.	28 Feb.	28 Feb.	28 Feb.
Golden Russet	18 Mar.	18 Mar.	24 Mar.	28 Mar.	5 April
Granny Smith	12 May	12 May	12 May	12 May	12 May
Gravenstein	10 Feb.	10 Feb.	10 Feb.	10 Feb.	20 Feb.
Hoover	2 April	2 April	6 April	16 April	16 April
Jonathan	30 Mar.	30 Mar.	31 Mar.	12 ,,	18 ,,
King David	15 ,,	15 ,,	20 ,,	29 Mar.	31 Mar.
London Pippin	30 ,,	30 ,,	31 ,,	3 April	6 April
Lord Wolseley	25 ,,	25 ,,	31 ,,	3 ,,	18 ,,
Newtown Pippin	30 April	30 April	2 May	3 May	10 May
McIntosh Red	10 Mar.	10 Mar.	12 Mar.	15 Mar.	25 Mar.
McLiver's Winesap	20 April	20 April	25 April	30 April	30 April
McMahon's White	5 ,,	5 ,,	8 ,,	9 ,,	14 ,,
Parlins Beauty	20 Mar.	20 Mar.	20 Mar.	3 ,,	3 ,,
Pioneer	25 April	25 April	25 April	10 May	10 May
Premier	20 Mar.	20 Mar.	24 Mar.	3 April	5 April
Ribston Pippin	23 Feb.	25 Feb.	28 Feb.	10 Mar.	10 Mar.
Rokewood	12 May	12 May	12 May	12 May	12 May
Rome Beauty	25 April	30 April	30 April	10 ,,	10 ,,
Salome	10 ,,	10 ,,	10 ,,	12 April	14 April
Scarlet Nonpareil	31 Mar.	31 Mar.	5 ,,	7 ,,	12 ,,
Scarlet Pearmain	10 Feb.	12 Feb.	12 Feb.	14 Feb.	25 Feb.
Senator	25 Mar.	25 Mar.	31 Mar.	3 April	12 April
Shepherd's Perfection	18 ,,	18 ,,	21 ,,	25 Mar.	5 ,,
Shorland Queen	14 ,,	14 ,,	14 ,,	15 ,,	25 Mar.
Simmonds' Winter	10 April	10 April	20 April	25 April	30 April
Spitzenberg	18 Mar.	18 Mar.	21 Mar.	25 Mar.	5 ,,
Statesman	10 May	10 May	10 May	10 May	12 May
Stark	10 April	10 April	10 April	20 April	20 April
Stayman's Winesap	5 ,,	8 ,,	8 ,,	14 ,,	14 ,,
Sturmer	12 May	12 May	12 May	12 May	12 May
Stone Pippin	12 ,,	12 ,,	12 ,,	12 ,,	12 ,,
Tasma	12 ,,	12 ,,	12 ,,	12 ,,	12 ,,
Wagner	5 April	5 April	8 April	9 April	15 April
Willie Sharp	28 Feb.	28 Feb.	28 Feb.	28 Feb.	28 Feb.
Worcester	10 ,,	12 ,,	12 ,,	14 ,,	25 ,,
Yates	12 May	12 May	12 May	12 May	12 May

2. Date Order for Varieties.

Variety.	Auckland.	Gisborne and Hastings.	Marlborough.	Nelson Province.	Wairarapa and Canterbury.
Gravenstein ..	10 Feb.	10 Feb.	10 Feb.	10 Feb.	20 Feb.
Scarlet Pearmain ..	10 ,,	12 ,,	12 ,,	14 ,,	25 ,,
Worcester Pearmain ..	10 ,,	12 ,,	12 ,,	14 ,,	25 ,,
Golden Pippin ..	28 ,,	28 ,,	28 ,,	28 ,,	28 ,,
Willie Sharp ..	28 ,,	28 ,,	28 ,,	28 ,,	28 ,,
Ribston Pippin ..	23 ,,	25 ,,	28 ,,	10 Mar.	10 Mar.
Blenheim Orange ..	2 Mar.	5 Mar.	7 Mar.	17 ,,	20 ,,
Cox's Orange ..	4 ,,	4 ,,	14 ,,	14 ,,	25 ,,
Alfriston	5 ,,	5 ,,	8 ,,	11 ,,	21 ,,
McIntosh Red ..	10 ,,	10 ,,	12 ,,	15 ,,	25 ,,
Shorland Queen ..	14 ,,	14 ,,	14 ,,	15 ,,	25 ,,
King David ..	15 ,,	15 ,,	20 ,,	29 ,,	31 ,,
Adams Pearmain ..	15 ,,	23 ,,	23 ,,	29 ,,	12 April
Shepherd's Perfection	18 ,,	18 ,,	21 ,,	25 ,,	5 ,,
Spitzenberg ..	18 ,,	18 ,,	21 ,,	25 ,,	5 ,,
Golden Russet ..	18 ,,	18 ,,	24 ,,	28 ,,	5 ,,
Premier	20 ,,	20 ,,	24 ,,	3 April	5 ,,
Boston Russet ..	18 ,,	18 ,,	31 ,,	3 ,,	10 ,,
Parlins Beauty ..	20 ,,	20 ,,	20 ,,	3 ,,	3 ,,
Baldwin	25 ,,	25 ,,	31 ,,	3 ,,	12 ,,
Senator	25 ,,	25 ,,	31 ,,	3 ,,	12 ,,
Lord Wolseley ..	25 ,,	25 ,,	31 ,,	3 ,,	18 ,,
London Pippin ..	30 ,,	30 ,,	31 ,,	3 ,,	6 ,,
Jonathan	30 ,,	30 ,,	31 ,,	12 ,,	18 ,,
Scarlet Nonpareil ..	31 ,,	31 ,,	5 April	7 ,,	12 ,,
Dunn's	31 ,,	31 ,,	7 ,,	7 ,,	18 ,,
Hoover	2 April	2 April	6 ,,	16 ,,	16 ,,
Cleopatra	5 ,,	5 ,,	5 ,,	12 ,,	12 ,,
Stayman's Winesap ..	5 ,,	8 ,,	8 ,,	14 ,,	14 ,,
McMahon's White ..	5 ,,	5 ,,	8 ,,	9 ,,	14 ,,
Wagner	5 ,,	5 ,,	8 ,,	9 ,,	15 ,,
Salome	10 ,,	10 ,,	10 ,,	12 ,,	14 ,,
Stark	10 ,,	10 ,,	10 ,,	20 ,,	20 ,,
Brownlee's Russet ..	10 ,,	10 ,,	20 ,,	25 ,,	30 ,,
Simmonds' Winter ..	10 ,,	10 ,,	20 ,,	25 ,,	30 ,,
Delicious	12 ,,	12 ,,	16 ,,	16 ,,	20 ,,
American Horn ..	20 ,,	20 ,,	22 ,,	25 ,,	30 ,,
Edward Lippiatt ..	20 ,,	20 ,,	20 ,,	25 ,,	30 ,,
McLiver's Winesap ..	20 ,,	20 ,,	25 ,,	30 ,,	30 ,,
Rome Beauty ..	25 ,,	30 ,,	30 ,,	10 May	10 May
Pioneer	25 ,,	25 ,,	25 ,,	10 ,,	10 ,,
Newtown Pippin ..	30 ,,	30 ,,	2 May	3 ,,	10 ,,
Frimley Beauty ..	30 ,,	30 ,,	30 April	3 ,,	5 ,,
Celo	3 May	3 May	3 May	3 ,,	12 ,,
Statesman	10 ,,	10 ,,	10 ,,	10 ,,	12 ,,
Ballarat	10 ,,	10 ,,	10 ,,	10 ,,	12 ,,
Crofton	10 ,,	10 ,,	10 ,,	10 ,,	12 ,,
Grannie Smith ..	12 ,,	12 ,,	12 ,,	12 ,,	12 ,,
Tasma	12 ,,	12 ,,	12 ,,	12 ,,	12 ,,
Stone Pippin ..	12 ,,	12 ,,	12 ,,	12 ,,	12 ,,
Sturmer	12 ,,	12 ,,	12 ,,	12 ,,	12 ,,
Brighton	12 ,,	12 ,,	12 ,,	12 ,,	12 ,,
Dougherty ..	12 ,,	12 ,,	12 ,,	12 ,,	12 ,,
Rokewood	12 ,,	12 ,,	12 ,,	12 ,,	12 ,,
Yates	12 ,,	12 ,,	12 ,,	12 ,,	12 ,,

LICENSED MEAT-EXPORT WORKS IN NEW ZEALAND, SEASON 1928-29.

Name and Address of Licensee.	Name and/or Location of Works.	Beef-killing Capacity per Day.	Sheep-killing Capacity per Day.	Storage Capacity, in 60 lb. Carcasses Mutton.
North Auckland and Auckland.				
Auckland Farmers' Freezing Company, Ltd., Auckland	Moerewa ..	200	2,000	100,000
" " "	Southdown ..	200	3,000	202,000
" " "	Horotiu ..	200	3,000	218,000
Westfield Freezing Company, Ltd., Auckland.. ..	Westfield ..	250	3,000	205,000
R. and W. Hellaby, Ltd., Auckland	Westfield ..	120	500	3,000
Hawke's Bay.				
Thomas Borthwick and Sons (Aus.), Ltd., Christchurch..	Pakipaki ..	30	1,800	70,000
Nelsons (N.Z.), Ltd., Tomoana	Tomoana ..	150	5,000	180,000
Hawke's Bay Farmers' Meat Company, Ltd., Hastings..	Whakatu ..	80	4,000	80,000
Wairoa Farmers' Co-operative Meat Co., Ltd., Wairoa ..	Wairoa ..	100	3,000	165,000
Gisborne.				
Nelsons (N.Z.), Ltd., Gisborne	Waipaoa ..	150	3,500	270,000
Gisborne Sheep-farmers' Frozen Meat and Mercantile Company, Ltd., Gisborne	Kaiti ..	150	4,000	422,000
Ditto	Tokomaru Bay	60	3,000	140,000
Taranaki.				
Thomas Borthwick and Sons (Aus.), Ltd., Waitara ..	Waitara ..	200	2,000	80,000
J. C. Hutton (N.Z.), Ltd., Wellington	Eltham ..	60	..	25,000
Patea Farmers' Co-op. Freezing Company, Ltd., Patea	Patea ..	150	2,000	180,000
Wellington.				
New Zealand Refrigerating Company, Ltd., Christchurch	Imlay ..	200	6,000	271,000
Feilding Farmers' Freezing Company, Ltd., Feilding ..	Aorangi ..	100	4,000	153,500
National Mortgage and Agency Company of New Zealand, Ltd. (Head Office, Dunedin)	Longburn ..	60	2,000	100,000
Thomas Borthwick and Sons (Aus.), Ltd., Christchurch	Waingawa ..	120	5,000	150,000
Gear Meat Preserving and Freezing Company of New Zealand, Ltd., Wellington	Petone ..	100	10,000	300,000
J. C. Hutton (N.Z.), Ltd., Wellington	Ngahauranga ..	120	3,000	120,000
Wellington Meat Export Company, Ltd., Wellington ..	Ngahauranga ..	120	8,000	240,000
" " " ..	Kakariki* ..	100	2,000	90,000
Marlborough and Nelson.				
New Zealand Refrigerating Company, Ltd., Christchurch	Picton ..	30	2,000	30,000
Nelson Freezing Company, Ltd., Nelson	Stoke ..	30	500	50,000
Canterbury.				
Canterbury Frozen Meat and Dairy Produce Export Company, Ltd., Christchurch	Belfast ..	120	6,000	252,000
Ditto	Fairfield ..	..	4,000	100,000
"	Pareora ..	25	4,500	233,000
New Zealand Refrigerating Company, Ltd., Christchurch	Islington ..	50	7,000	375,000
" " "	Smithfield ..	50	6,000	304,000
North Canterbury Sheep-farmers' Co-operative Freezing Company, Ltd., Christchurch	Kaiapoi ..	100	4,000	222,000
Thomas Borthwick and Sons (Aus.), Ltd., Christchurch..	Belfast ..	..	5,000	120,000
Otago.				
Waitaki Farmers' Freezing Company, Ltd., Oamaru ..	Pukeuri ..	..	3,500	230,000
New Zealand Refrigerating Company, Ltd., Christchurch	Burnside ..	50	3,500	216,000
South Otago Freezing Company, Ltd., Balclutha ..	Finegand ..	50	2,500	200,000
Southland.				
Ocean Beach Freezing-works (J. G. Ward and Co., Ltd., Managing Agents), Invercargill	Ocean Beach ..	50	2,500	110,000
Southland Frozen Meat and Produce Export Company, Ltd., Invercargill	Mataura ..	50	2,500	104,000
Ditto	Makarewa ..	120	2,500	75,000
Tait's Woodlands Meat Company, Ltd., Invercargill ..	Woodlands† ..	..	..	..
Totals	..	3,745	135,800	6,465,500

* Not operating. † Canning only.

—*Live-stock Division.*